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INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

(BEING A CONTINUATION OF THE 'ANNALS' COMBINED WITH LONDON AND
CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY'.)

CONDUCTED BY

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"Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiis felicitatis humanæ:—ex harum usu *bonitas* Creatoris, ex pulchritudine *sapientiæ* Domini; ex œconomiâ in conservatione, proportionè, renovatione, *potentiâ* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper æstimata; à verè eruditis et sapientibus *semper* exculta; malè doctis et barbaris semper inimica fuit."—**LINNÆUS.**

"Quelque soit le principe de la vie animale, il ne faut qu'ouvrir les yeux pour voir qu'elle est le chef-d'œuvre de la Toute-puissance, et le but auquel se rapportent toutes ses opérations."—**BRUCKNER, *Théorie du Système Animal*, Leyden, 1767.**

. The sylvan powers
Obey our summons; from their deepest dells
The Dryads come, and throw their garlands wild
And odorous branches at our feet; the Nymphs
That press with nimble step the mountain thyme
And purple heath-flower come not empty-handed,
But scatter round ten thousand forms minute
Of velvet moss or lichen, torn from rock
Or rifted oak or cavern deep: the Naiads too
Quit their loved native stream, from whose smooth face
They crop the lily, and each sedge and rush
That drinks the rippling tide. the frozen poles,
Where peril waits the bold adventurer's tread,
The burning sands of Borneo and Cayenne,
All, all to us unlock their secret stores
And pay their cheerful tribute.

J. TAYLOR, *Norwich*, 1818.



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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY

[SECOND SERIES.]

“..... per litora spargite muscum,
Nalades, et circum vitreos considite fontes
Pallide virgineo teneros hic carpite flores.
Floribus et pictum, divæ, replete canistrum.
At vos, o Nymphæ Craterides, ito sub undas,
Ite, recurvato variata corallia trunco
Vellite muscosis e rupibus, et inibi conchas
Ferte, Uen pelagi, et pingui conchyliis succo.”
N. Parthenii Giannettasis Eccl. 1.

No. 109. JANUARY 1857.

I.—*Notes of an Excursion to the Pyrenees in search of Diatomaceæ.* By WILLIAM SMITH, F.L.S., Professor of Natural History, Queen's College, Cork.

[With two Plates.]

IN the 'Annals' for January 1855, I had the opportunity of recording the results of a former excursion to the South of France and the Auvergne: the same object, namely to collect facts regarding the distribution of Diatomaceous forms, was the main purpose of the journey whose outline I now lay before the public.

My views on the present occasion were directed to the western shores of France, and the lofty range of granitic mountains which forms its southern boundary; and from the widely different influences affecting the flora of the Bay of Biscay and the Pyrenees, I anticipated results that would contrast, to some extent, with those furnished by the shores of the Mediterranean and the volcanic slopes of Mont Dore and the Puy de Dôme.

My route was as follows:—

I crossed from Southampton to Havre on the 14th June 1856, and spent a few days in exploring the mouth of the Seine and the neighbouring shores. The marine species here collected

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were almost identical with those already familiar to me on the southern coasts of England; but a fountain in the court of the hotel (Frascati) at which I sojourned, supplied a form which was different not merely in species, but in genus, from any I have hitherto recorded as British; this was the *Diadesmis* described in a subsequent part of the present paper. From an oyster tank at St. Address, about a mile north of Havre, I also made a gathering, which, on being prepared for mounting, supplied numerous valves of *Zygoceros Surirella*. This species I have placed in Appendix B. of the 'Synopsis of the British Diatomaceæ,' as described and figured by Mr. Roper in the 'Transactions of the Microscopical Society,' but as not sufficiently known to me to be admitted into the body of the work. I regret to say that I must still leave it undescribed. I did not detect it while the gathering was recent; and in cases where doubt exists, a diagnosis from a prepared slide is usually insufficient for the foundation of a species, or even the correct determination of the generic position of a Diatomaceous frustule. The same gathering furnished specimens of the rare British forms, *Nitzschia spathulata* and *Eucampia Zodiurus*; the latter is however more general than its rare detection might seem to imply, being only conspicuous in a fresh state, and becoming so diaphanous when prepared in acid as to elude the notice of observers. Excellent specimens collected from a small pool on the landing-slip at Birkenhead have lately been sent to me by Mr. T. Comber of Liverpool, and the species is probably distributed along most of the British shores.

On the 19th June I reached Falaise and spent a few days with M. de Brébisson, whose knowledge of algology, and more especially of the freshwater forms of the Diatomaceæ, has so often aided and illustrated my researches.

It was unnecessary for me to explore a district that had for years been subjected to the examination of so acute an observer, and a rough gathering from the public fountain in the "Place," graced with a noble statue of the Conqueror of England, was the only one made in this neighbourhood; it supplied a few common British species, among which *Gomphonema olivaceum* was largely predominant.

On the 28th July I proceeded by Alençon and Le Mans to Tours. The fearful inundations which had desolated the borders of the Loire and its tributaries a few weeks before my arrival, had borne off all accumulations of Diatomaceæ, and left little to detain me in this otherwise rich and beautiful country. Proceeding rapidly to the south, I passed through Bordeaux to the borders of the great salt lagoon lying a few miles to the south

of the mouth of the Garonne, and known as the Bassin d'Arca-chon; here I had anticipated an abundant harvest of marine forms, and my expectation would no doubt have been realized but for the extreme heat of the weather, which suddenly assumed a tropical character, drying up the smaller pools, and absolutely forbidding active exertion.

A few gatherings however furnished me with some interesting species; among others, with *Campylodiscus cribrus* and *Nitzschia scalaris*, the latter having been long confined in its known European distribution to the single locality in Poole Bay, where I had first detected it as a British denizen, and only within the last few months shown to have a wider range by its discovery by Mr. Okeden in Milford Haven. This species is in several respects important in reference to our present inquiry. Its great size and conspicuous markings render it easy of detection and identification, and the species-manufacturer has no excuse for elevating its varieties into new forms, and thus destroying its value as an index of geographical distribution.

Ehrenberg's figure, as copied in Kütz. Bacill. xviii. 32, is quite characteristic, and he gives Suinam as its locality. His only other locality of the recent frustule is Kourdisan, but this freshwater station is open to suspicion.

The references in the 'Microgéologie' to the presence of this form in deposits are all worthless, as no description is given, and the carelessness evident in the execution of the figures forbids us to accept them as representations of our present species. The ascertained distribution of *Nitzschia scalaris* is, therefore, from the northern shores of South America to the southern coasts of Britain, an area sufficiently large to establish the indifference of this Diatom to the climatal influences of latitude.

On the 3rd of July I proceeded to Biarritz. This is almost the only point on the long line of shore extending from Brittany to the Spanish frontier, where the coast is not low and sandy, and in the holes and pools perforated by the turbulent waters of the Bay of Biscay in the soft nummulitic rock, which here attracts the admiration of the geologist, I made a few collections that supplied me with two or three forms unknown to the British flora; these I have described in the sequel of this paper.

On the face of the cliff beneath the Villa Eugénie, the new château of the Empress of the French, I also made a freshwater gathering, containing a new *Epithemia*, which, in compliment to the locality and its amiable mistress, I have named *Epithemia Eugénie*.

On the 6th of July I proceeded through Pau to Eaux Bonnes and Eaux Chaudes, and near the latter place, on the route to the

Pic du Midi d'Ossau, collected a form new both to French and English algologists, but which has been detected in the Tyrol by A. Braun, and named by him *Gomphogramma rupestre*. It appears to be frequent in the Pyrenees, as I met with it in several other localities. I have described it in its proper place.

On the 10th of July I reached Caunterets, and during a stay of three weeks in that mountain village had ample opportunities of collecting the Diatomaceæ of the neighbourhood. A few of these will be found among my new species, but these are not so numerous as I had anticipated. The characters of the Pyrenean forms are only slightly modified from those of our own sub-alpine districts, and the careful systematist is obliged to regard such modifications as varieties rather than as new species.

The hot sulphureous springs which abound in the vicinity of Caunterets, although supplying "*Barrege*" in abundance, are not prolific in Diatomaceæ. The latter enter but rarely, and accidentally rather than substantially, into the composition of this curious substance, which mainly consists of various species of filamentous Alge, such as *Oscillatoria*, *Leptothrix*, and *Phormidium*.

Three others of the Pyrenean valleys, those of the Gave de Gavarnic, Gave de Barèges, and the Gave d'Adour, supplied me with numerous gatherings, without adding materially to the number or variety of the species collected at Caunterets.

I left Baguères de Bigorre on the 10th August, and reached Paris on the 13th, having made but one gathering on the route, from the fosse of the Château de Chambord near Blois, which however proved wholly devoid of either novelty or interest.

The gatherings made during the above excursion amounted to sixty-four; of these, nearly fifty contained species of more or less interest in a geographical point of view, being many of them identical with those collected on my former journey, and all of them with forms found in the British Islands, and described in the 'Synopsis of the British Diatomaceæ.'

I give a list of these, which I have divided into two classes.

1st. Those collected in marine or brackish-water localities on the western coasts of France.

2nd. Pyrenean forms found at elevations varying from 3000 to 7000 feet above the level of the sea; and I subjoin a list of those species or varieties not figured or described in the 'Synopsis.'

In the first two lists I have annexed a cipher to the name of the species, denoting the number of localities in which the form occurred.

1. Marine or Brackish-water Forms.

Number of gatherings made, 8.

Epithemia Musculus	1	Navicula Hennaodyii	2
Amphora affinis	2	— Westii	2
— salina	1	Pinnularia peregrina	5
— membranacea	1	— gracilis	2
Cocconeis Scutellum	6	— Cyprinus	3
— Scutellum, var. β	3	— directa	2
— diaphana	3	Stauroneis pulchella	2
— diaphana, var. β	2	— pulchella, var. β	2
Coscinodiscus eccentricus	2	Pleurosigma Balticum	2
— radiatus	3	— angulatum	1
Eupodiscus sculptus	1	— rigidum	1
Actinocyclus undulatus	4	— decorum	1
Cyclotella Kützingiana	2	Synedra affinis	3
Campylodiscus eribrosus	1	— Gallionii	2
— parvulus	1	— Gallionii, var. β	3
— bicostatus	1	— Arcus	2
Surirella striatula	2	— tabulata	1
— ovata	2	— undulata	1
— Gemma	3	Gomphonema marium	2
— fastuosa	2	Rhipidophora elongata	2
— constricta	1	Bacillaria paradoxa	1
Tryblionella Scutellum	1	Fragilaria striatula	1
— gracilis	2	Eucampia Zodiacus	1
— marginata	2	Achnanthes longipes	1
— acuminata	3	— longipes, var. γ	1
— levidensis	1	— brevipes	1
— constricta	2	Rhabdonema arcuatum	2
Nitzschia scalaris	1	— Adriaticum	1
— Tenuis	2	— minutum	1
— bilobata	2	Grammatophora marina	4
— Sigma	3	— serpentina	3
— angularis	2	— maculenta	2
— spathulata	1	Amphitetras antediluviana	1
— Closterium	1	Biddulphia pulchella	1
Amphiprora alata	2	— aurita	1
Navicula didyma	4	— Rhombus	1
— punctulata	1	Podosira hormoides	2
— Smithii	2	— Montagnei	2
— Liber	1	Melosira subflexilis	1
— pusilla	2	— nummuloides	3
— Crabro	1	Orthosira marina	3
— pygmaea	2	Schizonema cruciger	1
— palpebralis	3	— Grevillii	2

2. Pyrenean Forms.

Number of gatherings made, 56.

Epithemia Zebra	3	Epithemia ventricosa	2
— turgida	2	Eunotia Arcus	18
— rupestris	6	— diodon	1
— Argus	3	Cymbella Helvetica	9
— gibba	4	— Helvetica β	12

<i>Cymbella</i> Scotica	6	<i>Pinnularia</i> hemiptera	10
— Scotica β	5	<i>Stauroneis</i> anceps	3
— ventricosa	18	— gracilis	6
— affinis	8	— punctata	3
— sequalis	2	— linearis	2
— maculata	2	<i>Pleurosigma</i> attenuatum	3
— lunata	2	<i>Synedra</i> Ulna	24
— cuspidata	6	— Ulna β	2
<i>Amphora</i> ovalis	9	— lunaris	6
<i>Cocconeis</i> Pediculus	4	— tenera	6
— Placentula	17	— delicatissima	2
— Thwaitesii	4	<i>Gomphonema</i> constrictum	8
<i>Cyclotella</i> operculata	5	— capitatum	2
— Rotula	1	— capitatum β	8
<i>Campylodiscus</i> costatus	2	— tencellum	16
— costatus β	1	— insigne	1
— spiralis	2	— dichotomum	8
<i>Sarirella</i> biseriata	5	— acuminatum	5
— linearis	7	— acuminatum β	2
— pinnata	3	— olivaceum	1
— angusta	1	<i>Cocconeis</i> lanceolatum	10
<i>Tryblionella</i> acuminata	1	— cymbiforme	6
— angustata	3	— Costula	5
<i>Cymatopleura</i> elliptica	1	<i>Meridion</i> circulare	9
— apiculata	1	— circulare β	2
<i>Nitzschia</i> linearis	9	— constrictum	1
— tenuis	3	<i>Himantidium</i> pectinale	6
— Amphoxyis	2	— majus	2
— media	1	— gracile	5
— sigmoidea	1	— bidens	6
<i>Navicula</i> gibberula	3	— Arcus	6
— elliptica, Kütz.	15	<i>Odontidium</i> hyemale	26
— trinodis	3	— mesodon	11
— cryptocephala	6	— Harrisoni β	5
— firma	4	— mutabile	3
— firma, var. β	8	— Tabellaria	2
— firma, var. γ	4	<i>Denticula</i> obtusa	2
— rhomboides	5	— tenuis	12
— crassinervia	8	— ocellata	2
— Amphibicna	2	— sinuata	4
— angustata	6	<i>Fragilaria</i> capucina	3
— laevissima	4	— virescens	1
— Bacillum	2	<i>Achnanthes</i> exilis	12
<i>Pinnularia</i> viridis	16	<i>Achnanthidium</i> lanceolatum ..	6
— nobilis	2	<i>Diatoma</i> grande	5
— radiosa	3	<i>Tabellaria</i> flocculosa	9
— oblonga	1	<i>Melosira</i> varians	4
— gracillima	6	<i>Orthosira</i> arenaria	2
— borealis	8	— spinosa	4
— gibba	1	— punctata	2
— interrupta	3	<i>Mastogloia</i> Smithii	2
— Tabellaria	2	— Grevillii	2
— major	4	<i>Eucyonema</i> prostratum	4
— acuminata	2	— caespitosum	1
— lata	2	<i>Colletonema</i> neglectum	2
— Stauroneiformis	6	— vulgare	3

3. *Species or Varieties not described or figured in the 'Synopsis.'*

<i>Epithemia Eugeniæ</i> , n. sp.	<i>Synedra fontinalis</i> , n. sp.
<i>Amphora marina</i> , n. sp.	<i>Odontidium hyemale</i> , var. β , W. Sm.
<i>Tryblionella gracilis</i> , var. β .	— hyemale, var. γ , W. Sm.
<i>Navicula acuta</i> , n. sp.	— informe, n. sp.
— <i>Pyrenaica</i> , n. sp.	<i>Diatoma Ehrenbergii</i> , Kütz.
— <i>disimilis</i> , n. sp.	<i>Himantidium marinum</i> , n. sp.
<i>Cocconeina lanceolatum</i> , var. β , W. Sm.	<i>Melosira cribrosa</i> , Bréb.
— <i>lanceolatum</i> , var. γ , W. Sm.	<i>Diadesmia Gallica</i> , n. sp.
	<i>Gomphogramma rupestre</i> , Braun.

I add descriptions and figures of the forms contained in the last list.

Epithemia Eugeniæ, n. sp. F. V. inflated, with truncated extremities; S. V. lunate, extremities straight, truncate; canaliculi distinct, 8 in $\cdot 001''$; foramina conspicuous. Striæ 32 in $\cdot 001''$. Length $\cdot 0009''$ to $\cdot 0033''$. v.v.

Fresh water. Face of the cliff below the "Villa Eugénie" at Biarritz.

The nearest allies of this beautiful little species are *E. proboscidea* and *E. Sorex*. It may however be easily distinguished from the first by the much slighter inflation of its F. V. and its distinct foramina, from the second by its conspicuous canaliculi and their arcuate-like interspaces, and from both by the regular outline of its dorsal margin, and the absence of any recurvature at the extremities of the valve.

PLATE I. fig. 1. *Epithemia Eugeniæ*: a & b, S. V. of frustule; c, F. V. of ditto; d, F. V. of frustule undergoing self-division.

Amphora marina, n. sp. F. V. elliptical with somewhat truncate extremities; nodule very faint. Striæ 40 in $\cdot 001''$. Length $\cdot 0006''$ to $\cdot 0024''$. v.v.

Marine. French coast near Havre (June), and Biarritz (July 1856).

This form is not unfrequent on the British coast, but has hitherto been overlooked from its exact resemblance in outline to *A. affinis*; it may be known by its more delicate striæ and inconspicuous nodules.

PLATE I. fig. 2. Front views of *Amphora marina*.

Tryblionella gracilis, W. Sm. Synopsis of the British Diatomaceæ, p. 35.

Var. β . S. V. elliptical with subacute extremities. Striæ 12 to 16 in $\cdot 001''$. Length $\cdot 0009''$. Breadth $\cdot 0000''$. v.v.

Fresh water. Spring near the Salut Source at Bagnères de Bigorre.

A form somewhat larger than the present, and with fewer striæ, occurs in the Aberdeen gatherings of Drs. Dickie and Redfern, containing *Orthosira Dickien*, Thw., Synop. B. Diatomaceæ, vol. II. p. 60. This I am disposed to refer in like manner to the species above described.

PLATE I. fig 3 S V of *Tryblionella gracilis* β

Navicula scita, n. sp. Valves nitrescent; S. V. linear-elliptical, attenuate towards the extremities. Striæ slightly inclined, very faint, 45 in $\cdot 001''$. Length $\cdot 0012''$ to $\cdot 0032''$. Greatest breadth of V. $\cdot 00033''$ v.v.

Fresh water. At high elevations in the Pyrenees: Lac de Gaube, 5866 feet, Lac Gave de Lizez, 3000 feet; Mt. Hormigas, 5250 feet, near the Mahouat Source, 3804 feet, Lac d'Estom, 6566 feet.

PLATE II fig 4 S V of *Navicula scita*

Navicula Pyrenaica, n. sp. S. V. linear-lanceolate, slightly inflated at the extremities. Striæ obscure. Length $\cdot 0011''$ to $\cdot 0017''$. Greatest breadth $\cdot 0002''$. v.v.

Fresh water. Gave de Lizez near Caunterets, elevation 2634 feet; Gave de la Reine, elevation 2696 feet.

PLATE II fig 5 Side views of *Navicula Pyrenaica*

Navicula dissimilis, n. sp. Frustule oblique; S. V. elliptical; median line somewhat diagonal from the obliquity of the frustule, recurved at its extremities. Striæ obscure. Length $\cdot 0009''$. Breadth $\cdot 0003''$ v.v.

Fresh water. Mt. Pechineya near Caunterets, elevation 6222 feet; Lac de Gaube; cascade near St. Sauveur, elevation 3020 feet.

Notwithstanding the beautiful pink colour of the dry valve, indicating the presence of markings on its surface, I have been unable to resolve the striæ of this species so as to estimate their number.

PLATE II. fig. 6. Side views of *Navicula dissimilis*.

Cocconeoma lanceolatum, Ehr. Synopsis of the British Diatomaceæ, vol. i. p. 75.

Var. β . Convex margin much elevated, subangular. Length of valve $\cdot 0042''$ to $\cdot 0058''$. Greatest breadth of ditto $\cdot 0015''$.

Var. γ . Valve nearly direct, linear towards the rounded extremities. Length of valve $\cdot 0053''$. Greatest breadth of ditto $\cdot 0009''$. v.v.

Fresh water Gave de Lizez; Gave de la Reine near Caunterets.

I do not regard these forms as entitled to rank as established varieties of *C. lanceolatum*, but merely as representatives, at the two extremes, of the multitudinous changes of outline to which this Diatom submits, under climatal and other influences.

Ehrenberg has erected the second into a distinct species, under the name of *C. cornutum*: the first, and many of the others, have equal claims to this honour; but regarding the multiplication of book-species as one of the greatest obstacles to the progress of natural science, I forbear to increase their numbers.

PLATE I fig. 7 Side view of *Cocconeia lanceolatum* β Fig. 8. S. V. of *C. lanceolatum* γ

Synedra fontinalis, n. sp. Frustules scattered; S. V. linear-lanceolate, in the smaller specimens elliptical lanceolate, extremities produced, subcapitate, nodule indefinite. Striæ 27 in $\cdot 001''$. Length $\cdot 0006''$ to $\cdot 0014''$. Greatest breadth of valve $\cdot 00015''$ to $\cdot 0002''$. v.s.

Fresh water. Spring near the Salut Source at Bagnères de Bigorre.

PLATE I. fig. 9 *Synedra fontinalis*: a & a', side views; b, F. V. of frustule in self-division

Odontidium hyemale, Kütz. Synopsis of B. Diatomaceæ, vol. ii. p. 15.

Var. β . S. V. linear, extremities rounded. Length of frustule $\cdot 0018''$ to $\cdot 0012''$. Breadth of valve $\cdot 0004''$. v.v.

Var. γ . S. V. linear-elliptical, contracted towards the linear or subcapitate extremities. Length of frustule $\cdot 0011''$ to $\cdot 0025''$. Breadth of V. $\cdot 0004''$. v.v.

Fresh water. *Var. β .* Cambuscou near Caunterets, elevation 4920 feet; Pont d'Espagne near Caunterets, elevation 4930 feet. *Var. γ .* Eaux Chaudes, elevation 2296 feet; Val d'Ossau, elevation 2968 feet; Cascade Gavarnie, elevation 6294 feet.

Both these varieties occur intermixed with the ordinary frustules described in the 'Synopsis,' and with frustules of *O. mesodon*; all these appear to be forms of the same species, though the one described as *O. hyemale* in the 'Synopsis' is by far the most frequent, and is therefore entitled to be regarded as the normal condition of the mature frustule.

A curiously distorted condition of var. β , which I have figured in Pl. I. fig. 10 4, occurs in the Cambuscou gathering in tolerable abundance. This variety illustrates the tendency to a repetition of accidental deviations impressed by the self-dividing act, which I have noticed in the Introduction to the Synopsis, vol. ii. p. xxiii,

when cautioning the inexperienced observer against relying upon size or outline merely as the basis of specific distinctions. Had filaments with the above deviation been the only ones occurring in the Cambuscou station, an abnormal state of the frustule might have been regarded as its permanent form, and a specific character been founded on what was merely a morbid condition of its growth.

PLATE I. fig. 10. *Odontidium hyemale*. Var. β . *a*, S. V. of frustule; *a'*, S. V. of deformed frustule; *b*, front view of filament. Fig. 11. *a* & *a'*, side views of frustule; *b*, F. V. of filament.

Odontidium informe, n. sp. S. V. of frustule elliptical, with an irregular inflation at the centre, and hence subcruciform. Costæ not reaching the centre of the valve, 18 in '001". Length of frustule '0007". Greatest breadth '0003". v.v.

Fresh water. Lac Gave de Lizez, and Gave de la Reine near Caunterets.

The nearest ally of this species is *O. Harrisonii*, Synop. B. Diatomaceæ, vol. ii. p. 18; but the normal form of the latter not occurring in the Pyrenees, it is probable that the present is entitled to rank as distinct. *Odontidium Harrisonii*, var. β , Synop. vol. ii. pl. 60. fig. 374, is also a frequent form in my Pyrenean gatherings, and is also in all probability a distinct species, though, from its great similarity to the Hull frustules, I have, with most other observers, hitherto regarded it as a mere variety.

PLATE II. fig. 12. *Odontidium informe*. *a*, *b*, *c*, side views of frustule; *d* & *d'*, front views of ditto.

Diatoma Ehrenbergii, Kütz. S. V. linear-elliptical, constricted towards the slightly capitate extremities, costate. Costæ 80 in '001". Length of valve '0011" to '0017". Greatest breadth of ditto '00016" to '00028". v.v.

Kütz. Bacill. tab. xvii. 17; Sp. Alg. p. 17.

The inflation in the centre of the valve, with the constriction near the subcapitate extremities, exactly correspond with the figure and description given by Professor Kützinger, and separate the present species from *D. grande* of the 'Synopsis,' which is moreover a larger form with coarser striae.

PLATE I. fig. 13. *Diatoma Ehrenbergii*: *a* & *b*, side views of frustule; *c*, F. V. of ditto.

Himantidium? marinum, n. sp. Filament tenacious. S. V. slightly and regularly arcuate, extremities acute, costate.

Costæ distant, 10 in $\cdot 001''$. Length of frustule $\cdot 0018''$ to $\cdot 0036''$. Breadth of valve $\cdot 0001''$. v.v.

Marine. Very rare in rocky pools near Biarritz.

I am uncertain as to the true position of the above form: the filaments are direct as in *Fragilaria*, the frustules arcuate as in *Himantidium*, and the valves costate as in *Meridion*. As the second character seems the most important in the present case, I have placed the species provisionally in *Himantidium*, but a further and better knowledge of its habit and character may necessitate the adoption of a new generic appellation.

PLATE II. fig. 14. *Himantidium marinum*: a, S. V. of frustule; b, F. V. of filament.

Melosira cribrosa, Bréb. S. V. orbicular, cellulate; cellules all equal and hexagonal, 9 in $\cdot 001''$. Diameter of valve $\cdot 0025''$. v.s.

Marine. Bay of Biscay near Biarritz.

In December 1853 I received isolated frustules of this species, collected on the coast of Normandy, under the above name from M. de Brébisson, and I have since detected the same in a gathering from the Black Sea. In no case have I seen the frustules in a recent state, and do not know whether they ever form a lengthened filament. As this is the only circumstance that would justify their separation from *Coscinodiscus*, to which the separated valve would otherwise seem to belong (see Synop. B. Diatomaceæ, vol. i. p. 22), their position in *Melosira* must rest upon the authority of my accurate correspondent.

PLATE II. fig. 15. S. V. of *Melosira cribrosa*.

Genus DIADESMIS, Kütz.

Frustules naviculoid, united into a free or attached filament; valves elliptical with a median line, and central and terminal nodules.

Diadismus Gallica, n. sp. Filaments direct or curved. S. V. linear-elliptical. Striæ obscure, about 45 in $\cdot 001''$. Width of filament $\cdot 0003''$ to $\cdot 0004''$. Breadth of valve $\cdot 0001''$. v.v.

Fresh water. Fountain in the court of the Hôtel Frascati at Havre,

The genus *Diadismus* is not without an illustrative species in the British Islands, though the habitat of this species makes it doubtful whether it be really entitled to rank as indigenous. It was collected by Dr. Arnott in the tank of the *Victoria Regia* at

Kew Gardens in April 1856, and again by myself in the July of the same year; it is a larger form than the present, with a broader and more regularly elliptical valve and more distinct striæ. I propose to describe it in a future edition of the 'Synopsis' under the name of *Diadmesmis peregrina*.

PLATE II. fig. 16. *Diadmesmis Gallica*: a & b, S. V. of frustule; c, F. V. of filament.

Genus GOMPHOGRAMMA, Braun.

Filaments compressed, continuous, of few frustules, free; frustules annulate, indefinite; septa alternate, nearly equal; valves elliptical, costate.

Gomphogramma rupestre, Braun. S. V. irregularly elliptical, orbicular in young specimens. Costæ direct, 1 to 5. Width of filament '0002" to '0007". Breadth of valve '0001" to '0003". v.v.

Fresh water. Moist surface of high rocks: Gabas near Eaux Chaudes, elevation 3362 feet; near the Mahourat Source at Cauterets, elevation 3804 feet; old road near Pierrefitte, elevation 2006 feet; Lac de Gaube, elevation 5866 feet.

The structure of the frustules in this species bears so close a resemblance to that of *Tetracyclus lacustris*, that I should have referred them to the latter genus, had not M. de Brébisson informed me that the present species had been discovered by Professor Braun near Freiburg in Breisgau, and placed in the genus "*Gomphogramma*." In *Tetracyclus* the valve is cruciform and the costæ arched; in *Gomphogramma* the valve is elliptical and the costæ direct; but these seem rather to belong to specific than generic characters, and the propriety of uniting these genera hardly admits of a question. Should this course be adopted, it would be necessary to alter the name *Tetracyclus*, which would no longer be appropriate, and place the species of the two genera under the common name of *Gomphogramma*; but until British specimens of our present species be discovered, I do not propose to make this change of nomenclature. The generic characters of *Gomphogramma* will be better understood by the reader if he refers to the observations I have given under the genus *Rhabdonema* (Synopsis of British Diatomaceæ, vol. ii. p. 82).

PLATE I. fig. 17. *Gomphogramma rupestre*: a & b, front view of frustules; d & k, side view of ditto; c, f, g, h, l, m, & n, annuli with their septa.

The above descriptions include the principal novelties both in species and varieties noticed in the fresh gatherings made during this interesting excursion. The list might be greatly increased,

were I disposed to admit into it those forms which I have detected, after a careful examination, *sparingly* distributed throughout the material when finally prepared for mounting. But I am reluctant to put forward as new species, or even as well-established varieties, forms whose characters rest upon what my knowledge of these organisms obliges me to regard as insufficient and unsatisfactory evidence. Not to dwell upon the liability to accidental intermixture to which such materials are liable, which, as every practical microscopist is aware, defy his most careful attention, and frequently intrude upon a gathering from one locality stray frustules belonging to a very different habitat, I consider it impossible to decide upon the specific claims of any but the most conspicuously marked Diatomaceous forms, from an examination of a few isolated specimens. In such genera as *Cymbella*, *Navicula*, *Pinnularia*, *Cocconeia*, and others, where there exists great simplicity of outline combined with great diversity of size, a knowledge of the form under examination, from different localities and at different periods of development, is absolutely necessary to enable the observer to determine its specific character, and to warrant him in referring it to a known, or erecting it into a new, species. Better to leave its claims *sub lite* until more satisfactory evidence is afforded, than to introduce confusion into the nomenclature of the science, and uncertainty into our conclusions with regard to geographical distribution, by a hasty, insufficient, and temporary determination. The announcement of a new species is sometimes nothing more than the publication of the observer's imperfect knowledge: the forbearance which foregoes the *éclat* of a "discovery," is often a homage due to the inexhaustible resources and the infinite variety of nature.

II.—*On the Development of the Root-cell and its Nucleus in Chara verticillata (Roxb.)*. By H. J. CARTER, Esq., Assistant Surgeon H.C.S., Bombay.

[With a Plate.]

LAST year I found it necessary, on account of the investigations I was then making, to ascertain the physical features which the protoplasm of the first few cells of *Chara* presented on their development from the *nucule*; but, not requiring to go further, I merely commenced from the bursting of the vacuoles of the new protoplasm into each other, and followed this up to the full development of the rotatory motion*. Latterly I have found it

* Ann. and Mag. Nat. Hist. vol. xvii. pp. 110 & 111. pl. 8. fig. 35, 1856.

necessary to extend these researches, that I might ascertain also the changes which the nucleus presents in the freshwater Algae under cell-division, and having again chosen the roots of *Chara verticillata* for this purpose, I have been led to observe other features in the protoplasm which I had not before noticed, but which, together with the changes exhibited by the nucleus, I will now also describe.

Previously, however, it is advisable that I should state shortly, what has been published respecting the development of the roots of *Chara*, as well as that which is known of the formation of the nucleus generally, in the Vegetable Kingdom.

As regards the former, it has already been stated by C. Müller, in his excellent description of the development of *Chara**, that "as soon as the nucleary membrane [embryo-sac] began to burst through the sporular membrane [brown coat], like a bladder, and to expand it in a sacciform manner [to form the first cell of the plant-stem], it began to be developed in a sacciform manner on the opposite side" [to form the roots]. Nothing afterwards is mentioned about the roots, saving that "each utricle forms a rootlet, and others follow it from simple vesicular expansion of the nuclear membrane, so that it acquires at this end a complete head of root-fibrils†."

For what is known respecting the formation of the nucleus in the Vegetable Kingdom, I can quote nothing better than the result of Nägeli's researches, which he has summed up in the following manner, viz.:—"The nucleus originates in two ways; either free in the contents of the cell, or by division of a parent nucleus‡." The first mode is witnessed in the embryo-sac of the Phanerogamia (*Scilla cernua*, &c.), wherein "globular drops of perfectly homogeneous mucilage with a defined outline" appear; after which the larger ones present an "enclosed ring;" and of these, he adds, "there can be no doubt, for the further development also confirms it, that the mucilage-globule is a cell-nucleus, the enclosed ring a nucleolus." He is also of "opinion that the nucleolus originates first, and the nucleus subsequently around it§;" lastly, he observes, "certain phenomena connect themselves readily with the hypothesis that they [the nucleoli] are utricles||."

As regards the second mode of origin, viz. that by division, this is witnessed in the nuclei which are formed on each side of

* Ann. and Mag. Nat. Hist. vol. xvii. p. 254, 1846.

† *Idem*, p. 259.

‡ Henfrey's Translations, Ray Soc. Pub. "Reports and Papers on Botany," 1849, p. 168.

§ *Idem*, pp. 106 & 107.

|| *Idem*, p. 172.

the "secondary nucleus in the parent-cell of the spore of *Anthoceros**."

Having thus briefly stated, as far as I am aware, the limits of our knowledge respecting the development of the roots of *Chara*, and the formation of the nucleus of the plant-cell, I will proceed to the subject of this paper, premising a short description of the first root-cell and its contents in the species of *Chara* mentioned, that the reader may recognize without doubt the parts to which I shall have occasion to allude.

This cell is a long narrow cylindrical tube, with one end attached to the *nucule*, and the other free. Its chief elements are the cell-wall and "primordial utricle" of Mohl.

Of the cell-wall nothing more need be said here than that it is as transparent, colourless, and apparently structureless, as unstained glass; but the protoplasm is composed of many organs, which I will first enumerate and then describe in detail. Thus, it is itself surrounded by a cell which we shall call the "protoplasmic sac;" then the protoplasm is divided into a fixed and rotatory portion; these again respectively enclose the nucleus, "granules," and axial fluid; while those small portions of matter which I have before designated as "irregularly shaped bodies†" are common to both.

Protoplasmic Sac.—This sac I have only been able to demonstrate satisfactorily by the aid of iodine and acids applied to the fixed protoplasm when it is about to undergo division for the second root-cell, in the way which will be hereafter mentioned. Its existence, however, might be inferred, from iodine and acids failing to produce any separation between the fixed and rotatory portions of the protoplasm; for these cannot be considered to be in direct union, and therefore, unless supported in their relative position by a membranous sac common to both, would most probably present a line of separation under contraction. Again, the "primary" nucleus ultimately becomes stationary in the midst of the rotating protoplasm, and it also must be fixed to something which is not only stationary itself, but is also carried inwards with this part of the rotating protoplasm, when the latter is condensed and made to leave the cell-wall by acids; for the nucleus, or what remains of it, is at such times seen to be enclosed in the general mass of contracted cell-contents. Lastly,

* *Idem*, 1846, pp. 261 & 262.—*Himantidium pectinale* (Kg.) affords a good example of it among the Algae; and in the same way I have seen it in some of the cells projecting into the gum-cavities of the bark of *Hyperanthera Moringa* (Roxb.), the *Horse-radish tree* of India; that is, both halves of the nucleus remaining opposite each other, on either side the septum, after the latter has divided the old, from the new cell.

† Ann. and Mag. Nat. Hist. vol. xvii. p. 106, 1856.

when the first root-cell assumes part of the function of the cell of the plant-stem, which is frequently the case, the green, peripheral cells appear in an abortive form, disposed in broken scattered lines along its inner surface, and they also are drawn inwards with the general mass of rotating protoplasm under contraction from acids,—with the remains of the nucleus within them again. Now these cells can hardly be supposed to be supported in their position by mere attachment to the cell-wall in the root-cell, any more than they are in the cell of the plant-stem, where they form a distinct layer. Hence, if the protoplasmic sac had not been seen, its existence might thus have been fairly inferred.

Protoplasm.—The protoplasm is a molecular mucus, which, as before stated, is divided into two portions, viz. a fixed and a rotatory portion. The fixed portion occupies the extremity of the cell, and extends backwards for about a hundredth part of an inch (Pl. III. fig. 2 *b, b*), while the rotating portion occupies all the rest of the interior of the tube (*c*). The latter, which is more attenuated than the former, merely encloses the axial fluid, and presents a few of the “irregularly shaped bodies” scattered through its substance, with, perhaps, a globular cell or two in its cavity; but the fixed protoplasm not only also contains a few of these “bodies,” but, in addition, the nucleus, and the group of corpuscles at the extremity of the cell, which I have called “granules.”

Nucleus.—This organ is at first located in that end of the fixed protoplasm which joins the rotatory part (fig. 2 *d*), and then consists of three elements: viz. a transparent, globular cell, which Nägeli has called the “nuclear utricle” (*a*); a more or less transparent mucus, which partly occupies its interior (*b*); and the nucleolus or kernel, which is a spherical body composed of an opaque, yellowish, homogeneous substance, with a single hyaline vacuole in its centre (*c, d*). This is the primary form of the nucleus in *Chara*. Afterwards it enlarges, the transparent portion of cell becomes elliptical, the nucleolus becomes flattened, its single hyaline vacuole is replaced by several which vary in size as well as in number (fig. 3); and these again disappear and reappear, but whether from collapse of the vacuole or change in position of the substance of the nucleolus, I am ignorant. The nucleolus is also now continually but imperceptibly varying its shape, being at one time elongated, and at another subrotund. Finally, when the nucleus has ceased to subdivide for the purpose of furnishing the new cells with nuclei, it moves backwards a short distance, and then becomes permanently fixed to the protoplasmic sac (fig. 4 *d*), where it grows still larger, and, ultimately, its nucleolus divides up into a number of small

nucleoli (fig. 5 *d*). When the second or following root-cell becomes terminal, that is, ceases to throw out any more cells, the nucleus, after the breaking down of the fixed protoplasm, moves about for some time before it becomes fixed; and this is effected partly by the rotating protoplasm and partly by its own locomotive power, which at this time is particularly evident, from gradual change of form while under observation. I have stated that the "nuclear utricle" and its contents are transparent, but this is only in comparison with the turbid fixed protoplasm in which it is imbedded; for when it gets into the clearer cavity of the rotating protoplasm, it not only presents a cloudiness interiorly, but, a certain time after it has become stationary, also becomes filled with vacuoles (fig. 12 *a*), like those which will be found to be developed in the fixed protoplasm preparatory to its assuming a more attenuated form and mingling with the rotatory part. In short, this is the last vital phenomenon presented by this organ; after which it passes into an effete amorphous piece of tissue like cellulose (fig. 6 *d*).

Round or "irregularly shaped bodies."—These are small opaque yellowish masses of protoplasmic (?) matter (fig. 2 *e, e, e*), irregularly scattered throughout both the fixed and rotating protoplasm, and seem to be the same as those which I have described under this head in giving an account of the contents of the protoplasm of the internode of the plant-stem, but they never grow large enough to arrive at those fantastic shapes which are found in the latter*. Like these, also, they are frequently seen appended to, or in the wall of a globular mucus-cell (fig. 14 *a, b*); and this cell may be transparent or clouded by the presence of molecular mucus, while it also frequently manifests a power of movement. Many of these bodies have very much the appearance of the small nucleoli into which the primary nucleolus divides, but as they appear in the cell before the latter takes place, this cannot be their origin.

Granules.—Lastly we come to the granules (fig. 2 *f, &c.*), which are of much interest, on account of their being grouped together in one part of the cell only, their marked characters, and their incessant oscillatory motion. They are situated in the fixed protoplasm close to the free extremity of the cell-wall, and are recognized by their dark margins, greenish colour, constant motion, and tendency to keep together in a group. At first they are round or elliptical (fig. 15 *a*), and of the tint mentioned, but after a while they become subrotund or angular, and colourless (*b*)—apparently effete. When the fixed protoplasm begins to be broken up by the development of vacuoles, they are seen to be scattered

* Ann. and Mag. Nat. Hist. *loc. cit.* p. 106, &c., pl. 8. figs. 11–13.
Ann. & Mag. N. Hist. Ser. 2. Vol. xix. 2

among the latter; but after the rotatory movement is completely established, they are no longer to be recognized. Their office seems to be connected with the extension of the cell, as they are only found at its extremity and are in constant motion, but whether this motion is produced by themselves or by the protoplasm in which they are imbedded, I am ignorant. They are also present in the young cell of the plant-stem, but disappear in the way which I have stated, and are then followed by the appearance of the rudiments of the green cells or chlorophyll-bearing cellulæ. Is their office of a like nature, or are they homologous with the latter?

Vacuoles.—These form no part of the permanent contents of the protoplasm, but are hyaline spaces, which are temporarily developed in the new or fixed protoplasm preparatory to its becoming attenuated and rotatory (figs. 3 i & 5 m). As they increase in number and size so they burst into each other, until a large space is thus produced in the centre, round which the protoplasm gradually begins to rotate (fig. 6 t). As before stated, they appear in the nucleolus and in the mucus-substance of the nuclear utricle when the nucleus becomes stationary; they also make their appearance in the rotating protoplasm, just preceding its death.

Having now described one of the first root-cells specially and typically, let us turn our attention to the whole bunch as they appear about twenty-four hours after the germination of the *nucule*. Here we shall find, as Müller has stated, that they are developed from the "nuclear membrane" (fig. 1 h, h') (which, for convenience of description, we will now term "embryo-sac"), on one side the plant-stem,—at first as one hemispherical cell, which afterwards divides into four or more root-buds (f). The first cell of the plant-stem (b), on the other hand, projects from the extremity of the embryo-sac in the form of a parabola, whose summit (d) becomes cut off, for the second cell or internode (e), by a transverse diaphragm (i); round the circumference of which, again, on the lower side (e, e), there is an annular projection, which lodges the protoplasm, that afterwards becomes cut off and divided up into cells for the first node or verticil; thus allowing direct endosmosis to take place, not only between the first and second cells of the plant-stem, but also between the first cell and the cells of the first node. Sometimes these cells pass into roots, as the cells of any future node may do if the occasion requires it. The figure of the germinating *nucule* which I formerly gave, would have been more complete had I drawn another diaphragm close to the summit of the *nucule*, and placed the roots in a bunch on one side of it, but the reader can do this for himself, and then he will have the first cell of the plant-stem

and first bunch of roots now described*. When a second plant-stem is formed, which is not unfrequently the case, this is developed out of one of the root-buds; hence it is not uncommon to see one of the latter in an intermediate state.

Now if we take the simple root-cell (fig. 2) about the eighteenth hour after germination, when it will be about half an inch long and $\frac{1}{800}$ of an inch broad, and place it in water between two slips of glass for microscopic observation, under a magnifying power of about 400 diameters, we shall find, if the circulation be active and the cell-wall strong and healthy, that the extremity of the latter, together with the nucleus and fixed protoplasm, which, as before stated, is about a hundredth part of an inch long and $\frac{1}{800}$ broad, will, in the course of about twenty-four hours, present the following changes:—

1st stage.—The nucleus, now about $\frac{1}{800}$ of an inch in diameter, is situated in that part of the fixed protoplasm which is next the rotating one; it is also now globular, and its nucleolus, which is about the $\frac{1}{800}$ of an inch in diameter, spherical and opaque, with the exception of the single hyaline vacuole in the centre. After this, the nucleolus becomes somewhat flattened, its outline becomes subcircular, and it presents several hyaline vacuoles of different sizes. The “granules” are now also in active motion at the other end of the fixed protoplasm, close to the extremity of the cell-wall, but, beyond these and the “irregularly shaped bodies,” the fixed protoplasm presents nothing to interrupt its uniformity throughout its whole extent.

2nd stage.—After a certain time, during which the nucleolus has been successively changing its shape from a subrotund to an elongated form, and *vice versa*, it assumes a grumous appearance, becomes slightly enlarged, and growing fainter in its outline, gradually but entirely disappears, leaving a white space corresponding to its capsule or cell-wall, with a faint remnant of some structure in the centre. Subsequently this space becomes filled up with the fixed protoplasm, and after about an hour and a half, (but this varies,) the nucleus reappears a little behind its former situation, but now reduced in size, and with its nucleolus *double*, instead of single as before (fig. 9); each nucleolus being about one-fourth part as large as the old nucleolus, and hardly perceptible. Meanwhile a faint septum (fig. 8 *g*) is seen obliquely extending across the fixed protoplasm, a little beyond the nucleus; and, if iodine be applied at this time, the division is seen to be confined to the protoplasm, as the latter, from contraction, withdraws itself from each side of the line where the septum appeared, and

* Ann. and Mag. Nat. Hist. *loc. cit.* p. 106, &c., pl. 8. fig. 35.

leaves a free space which is bounded laterally by an uninterrupted continuation of the protoplasmic sac. Hence the demonstration of the existence of this sac to which I have alluded. At this moment a spot, slightly lighter than the rest of the protoplasm, makes its appearance a little beyond the septal line towards the free extremity of the cell, and this is soon followed by the faint appearance of something else in its centre, which, as both become more defined, proves the former to be a new nucleus, and the latter, its nucleolus (*k*). We shall, therefore, henceforth designate the first by the name of "primary," and the second by that of "secondary" nucleus. As the secondary nucleus becomes more evident, its nucleolus also is found to be *double*, and composed of two spherical nucleoli about the same size as those of the primary nucleus, when the latter first returned into view. These nucleoli, like those of the primary nucleus, also become opaque and yellowish, and each presents a single hyaline vacuole or circular area in its centre—sometimes more than one.

The nucleoli of the primary nucleus, after they have become distinct, soon unite (fig. 10) and form one spherical nucleolus (fig. 3 *k*), with a single hyaline vacuole in its centre, thus assuming the form which it first presents when the root has just budded forth from the root-cell of the embryo-sac (fig. 2 *d*). After this the nucleoli of the secondary nucleus also unite in the same way, and present the same spherical form when conjoined.

The primary nucleolus now becomes more opaque, subrotund or elongated, and presents a number of vacuoles of different sizes (fig. 3 *d*); while the septum has become fully formed and has assumed a sigmoid shape (*g*). Thus the second root-cell is completely cut off from the first.

3rd stage.—In this, the cell for the first bunch of rootlets is formed and provided with a nucleus; it commences in a convex, lateral projection of the first root-cell opposite the oblique sigmoid septum (fig. 3 *h*). The primary nucleus now disappears again and undergoes precisely the same changes as those which it did for providing the nucleus for the second root-cell, but its counterpart now appears in the protoplasm occupying the lateral projection (fig. 4 *l*), which also presents a faint septum (*i*) dividing it from the remaining part of the fixed protoplasm, in which the primary nucleus is still imbedded.

As the third nucleus, or that of the lateral cell, becomes more defined, and its nucleoli unite together in the way just described, the septum becomes more evident, and at length we have the lateral cell completely cut off from the first root-cell, and provided with its nucleus (*h*).

Vacuoles now appear in the fixed protoplasm surrounding the primary nucleus preparatory to its being broken down into the rotatory form (fig. 3 i).

4th stage.—Here the fixed protoplasm surrounding the primary nucleus becomes entirely broken down by the vacuoles, and the whole of it, blending with the adjoining rotatory portion, now flows freely with the latter, over the septum both of the second root and lateral or rootlet-cells (fig. 4 k). While this has been taking place, the primary nucleus has moved a little backwards, and has become permanently fixed to the protoplasmic sac, where the cell-wall has also become elliptically dilated, apparently to receive it (*d, d'*). Vacuoles make their appearance in the midst of the protoplasm of the second root-cell near its septum (fig. 5 m); while this cell, now elongated, also gets a twist to one side, from the increased development of the rootlet-cell.

The nucleus in the lateral cell now disappears and returns in the way before mentioned, viz. in two parts, each containing two nucleoli. These undergo the same changes as those before described, ending in a conjunction of the nucleoli of each nucleus (*o, o*). Meanwhile a longitudinal septum has become developed in the lateral cell (*n*), which is thus divided into two, respectively provided with nuclei.

The second root-cell has become more elongated, and the vacuoles have worked a cavity in it, round which the protoplasm is slowly rotating (fig. 6 t).

The lateral cell has become divided again by a transverse septum (*s*), which has been accompanied by a division of the nucleus and quadrissection of the nucleolus as before stated; so that there are now four divisions in the lateral cell, each of which presents a single nucleus with a single nucleolus, respectively formed in the way mentioned (*q, q, q, q*).

5th stage.—The second root-cell has reached the state of the first previous to the appearance of the secondary nucleus (fig. 6 a); each of the four lateral cells has become elongated, but in different degrees, as in the case of the roots developed from the root-cell of the embryo-sac; one or two in the latter are generally much longer than the others. Meanwhile the primary nucleus has become enlarged, has presented the vacuoles in its mucus-contents to which I have alluded, and its nucleolus has become divided up into a number of small opaque nucleoli (fig. 5 d). These disappear and leave the old nucleus in the form of a flat, elliptical, structureless, effete piece of cellulose (?) (fig. 6 d); or the nucleus becomes prolonged backwards in the form of a long cell, and the small nucleoli drawn out with it into different shapes and lengths (fig. 13 a, a, a). What becomes of the small

nucleoli into which the nucleolus divides, I am ignorant; whether they become absorbed, or whether they escape from the nucleus into the rotating protoplasm. Judging from what takes place in the cell of the plant-stem, the latter would seem to be their destination; but, whatever it may be, all trace of them ultimately disappears in the remaining portion of the nucleus.

Thus far, then, we have seen, that the second root-cell and rootlet-cell developed from the first root-cell correspond, in development, with the first cell of the plant-stem and root-cell of the embryo-sac. Moreover, when the second root-cell is prolonged, it undergoes the same changes as the first cell, by which repetition we seem to get further confirmation of what goes on in the embryo-sac before germination becomes evident. All that takes place previous to this, however, is completely shut out from us by the black, opaque colour of the middle coat of the *nucule*, which causes the early part of germination to be as invisible as the glassy transparency of the cell-wall of the root renders its development apparent. Hence, for all that occurs antecedently, we must be guided by inference, and for views on this part of the subject, I can refer the reader to no higher authority than A. Braun, whose observations on the "*Nucleus of the Characeæ*" are among the papers which have been so happily selected and translated for the advancement of botanical science by Prof. A. Henfrey*. I would here, however, casually notice, that the embryo-sac which turns blue under the action of iodine and sulphuric acid before germination, ceases to do so after the latter has commenced.

It may now be asked, What becomes of the nucleus when it disappears? In reply to which I can state no more than I have already done,—viz. that all it leaves behind is a clear space, corresponding to the form and size of its capsule or cell-wall, with some faint amorphous tissue in the centre, and that this space also soon becomes obliterated or filled up by the fixed protoplasm, after which no trace of the nucleus remains. Its coming into sight again, with its counterpart too, is so faint, that it seems almost hopeless to endeavour to trace the changes between its disappearing and reappearing again,—reduced in size and with double nucleoli, as I have before stated. But this is certain, that one part moves towards the free end of the root-cell, viz. the secondary nucleus, and the other part, viz. the primary part, retires from it, while the septum is formed between the two in the lighter space of the fixed protoplasm originally occupied by the primary nucleus before its disappearance. It is also worthy of remark, that the part intended for the primary nucleus generally

* Ann. and Mag. Nat. Hist. vol. xii. p. 297, 1853.

appears first, and its nucleoli unite together long before those of the secondary nucleus; while, although the opposite sometimes takes place, it is rare, for I have only observed it twice.

As regards the influence of the nucleus upon the development of the new cells, it will now be evident that, if there be any, it must be derived in the first instance from the parent nucleus, for both the extremity of the second root-cell and the projection for the lateral or rootlet-cell take place before the disappearance of the primary nucleus for providing each of these parts with a new nucleus. But as soon as a trace of the septa respectively cutting off these cells from the remaining portion of the fixed protoplasm, and, therefore, from the old or first root-cell, is visible, the new nuclei respectively also appear in their proper situations; after which the further development of the nuclei and septa progresses *pari passu*. Thus the new cells are never entirely without a nucleus, which would thus appear to exert some influence, directly or indirectly, upon their development, for as soon as the *only* two new cells which the root-cell gives off are formed, the old nucleus becomes effete. At the same time, the general functions of the cell do not depend on the nucleus, for the cell grows larger and the circulation of the rotatory protoplasm continues for an indefinite period after it has ceased to exist; the latter apparently with even greater activity than when it was in full operation. Whether a new cell-bud can originate a new nucleus for itself, or go on growing to the extent of a nucleated cell without a nucleus, I am ignorant. But I am inclined to the opinion that it can do neither, and, therefore, opposed to the view I formerly expressed, when I knew less about the development of the roots of *Chara*, viz. that the root-cells of *Chara*, like the gemmule-buds on the body of *Vorticella*, might be developed "independently of the cell-nucleus*." I should hesitate, therefore, to assert now, that we might state this with certainty even respecting *Vorticella*.

Why the nucleolus should quadruplicate, while the capsule or "nuclear utricle" only (?) duplicates, and, when the division of the latter has been completed, the two nucleoli in each half should unite again into single nucleoli, I am also ignorant. That the nucleus in *Chara verticillata* does invariably undergo this process in the providing of nuclei for new cells, several single and several repeated serial sets of observations on different root-cells enable me to assert. So evident is this, that on one occasion the nucleoli of the secondary nucleus remained separate for five hours, during which they not only constantly changed their position, but grew larger, so that I thought they would

* Ann. and Mag. Nat. Hist. vol. xviii. p. 237, 1856.

never unite, and therefore watched for the time of their provisioning the *third* root-cell; when at the end of the fifth hour union commenced, and an hour afterwards was complete. Twelve hours after, this nucleolus also disappeared; and about an hour and a half from this time, the oblique septum dividing the second from the third root-cell was just visible, with the parent nucleus and its counterpart on each side of it respectively. Can the conjugation of the nucleoli, if it may be so termed, have anything to do with the reproduction or restoration of the size of the nucleus, as in some species of *Spirogyra* and *Diatomeæ*, where the contents of two cells, which have been derived from an interseptal division of one, unite again to form the spore? The same kind of quadruplication of the nucleolus appears to take place in the formation of the plant-cell of *Chara*, judging from two instances which occurred to me; and in looking for this generally it may be remembered that, whenever double nucleoli are seen in the nuclear utricle of *Chara*, it is a sure sign of this process having taken place, for even if the parent nucleus is ever in such a condition, it is at that time invisible.

On one occasion I found two nuclei with their two nucleoli respectively still disunited, in the axial fluid of the rotating protoplasm, while each nucleus was reduced to a clear transparent oblong cell; and on looking for the primary nucleus in its natural position, as well as for the nucleus of the rootlet-cell, the projection for which was already somewhat advanced, I found that they were both absent, while the presence of vacuoles in the protoplasm filling the projection for the rootlet-cell, which was not yet cut off from the parent, showed not only that this protoplasm was undergoing solution, but, also, that the development of the rootlet-cell had been arrested. No doubt, therefore, remained in my mind that the two nuclei in the axial fluid were the primary nucleus and the nucleus of the rootlet-cell. In these instances the nucleoli were clearly seen, and they presented the form of spheres filled or lined with a semi-opaque, homogeneous, yellowish substance, in the centre of which, on the surface of each, was a circular hyaline area or vacuole. In the nucleus nearest the free end of the root-cell, whose nucleoli were separated for some distance from each other (fig. 11), a transparent cell round each nucleolus could be perceived (*a, a*), but this was not apparent in the nucleus which was furthest from the end of the root-cell, whose nucleoli were in contact. The position of these nuclei, away from their proper situations, does not seem inexplicable, when we remember the migrating power of this organ, the want of a septum to keep the nucleus of the root-cell in its place, and the vacuolar solution that the fixed protoplasm was undergoing in which they ought to have been

imbedded; nor can the approximated state of the nucleoli in one nucleus and their separation in the other, coupled with their relative position in the cavity of the rotating protoplasm, fail to point out which was intended for the primary nucleus, and which for that of the rootlet-cell. Thus these nuclei, being in the clear cavity of the axial fluid instead of in the fixed protoplasm, afforded a much better view of the condition they and their nucleoli would probably have been in, had they remained in their natural situations; and the duality of the nucleolus indicating a recent division of the mother nucleus, while the second cell had been provided, left, with what has been before stated, no doubt in my mind, that this must have been the second division of the primary nucleus for provisioning the rootlet-cell.

It is by no means uncommon, moreover, to find the nucleolus of the primary nucleus elongate and irregularly subdentate at the border, and half an hour afterwards to find it subrotund, and so on to change from elliptical to subrotund successively for several times, as before stated. I have also mentioned the appearance and disappearance of the vacuoles in it, which Nägeli calls "froth" (*loc. cit.*); and the evidence of locomotive power in the nucleus itself, or in what Nägeli calls the "nuclear utricle." I have, however, never seen any granular matter in it, neither have I ever seen any granular matter in the mucus-contents of the nucleus with the microscopic power mentioned; but, like the nucleolus, it presents vacuoles, though this is only preparatory to becoming effete. The nucleolus sometimes presents a grumous appearance, as before stated, but this is, generally, just before it disappears, and I am not certain whether it does not depend on an increase in the number of vacuoles.

Iodine makes the nucleolus contract and assume a deep brown-red colour, which yields to water. Sulphuric acid causes it to swell up and disappear instantly, leaving nothing but the nuclear utricle behind, unaffected; just as when the nucleolus disappears preparatory to the formation of a new cell. If, however, a weak solution of iodine be first added, so as only to contract the nucleolus slightly, the sulphuric acid does not act so rapidly, and then it may be seen to expand under the eye until its outline alone remains visible, with the vacuoles, which do not disappear under these circumstances. I have never been able to demonstrate a capsule round the nucleolus *in situ*, whether young or old, double or single, though I have tried in various ways to do so, from the deceptive appearance which it frequently presents of having one; nevertheless, in the case mentioned where the nucleus was not *in situ*, a transparent capsule did appear to exist round each nucleolus. When the nucleolus be-

comes invisible, or very faint under the action of sulphuric acid, iodine fails to restore its form, or render it more distinct; and in no instance have I ever been able to produce the characteristic blue colour of starch in any part of the nucleus.

We now come to the offices of the nucleus, of which nothing more is revealed to us in the development of the roots of *Chara*, than that, so long as new cells are to be budded forth from the one to which the nucleus belongs, the nucleus continues in active operation, but when this ceases it becomes effete; while the rotation of the protoplasm and subsequent enlargement of the cell, &c., which are much better exemplified in the plant-stem than in the root-cell, go on after the nucleus ceases to exist. Hence the development of the root-cells of *Chara* affords us nothing positive respecting the functions of this organ; and, therefore, if we wish to assign to it any uses in particular, they must be derived from analogy with some other organism in which there is a similar nucleus whose office is known. Now, if for this purpose we may be allowed to compare the nucleus of *Chara* with that of the Rhizopodous cell which inhabits its protoplasm, we shall find the two identical in elementary composition; that is, both consist at first of a "nuclear utricle," respectively enclosing a structureless, homogeneous nucleolus; the latter, too, in both, is endowed with a low degree of movement. After this, however, the nucleolus of the *Rhizopod* cell becomes granular and opaque; and, when, under circumstances favourable for propagation, a new cell-wall is formed around the nuclear utricle,—or this may be an enlargement of the nuclear utricle itself,—I do not know which; the granular substance of the nucleolus becomes circumscribed, and shows that it is surrounded by a spherical, capsular cell; the granules enlarge, separate, pass through the spherical capsule into the cavity of the "nuclear utricle;" a mass of protoplasm makes its appearance, and this divides up into monads, or, as I first called them, "gonidia*." The nucleolus of *Chara*, on the other hand, after having provided the two cells developed from its own root-cell, becomes stationary, and also divides up into a number of small, round, graniform nucleoli, which disappear in some way or other unknown to me, leaving the nuclear utricle, at least, effete. Whether these small nucleoli are ultimately dissolved, or find their way into the rotating protoplasm, I am, as I have before stated, ignorant; but, so far as this multiple division goes, we have an analogous termination between the nuclei of these two organisms; and when we remember that the nucleus of the cell in which the *globule* of *Chara* originates, must furnish all the cells with nuclei which bear respectively the antherozoids,—that these nuclei are very

* Ann. and Mag. Nat. Hist. vol. xvii. p. 101, 1856.

small, so small indeed that they are but granules in size, compared with the nuclei of the plant and root-cells,—it does not seem far-fetched to assume that the nucleus is an organ of generation.

Further, should it hereafter be proved that the rhizopodous cells are developments of *Chara* itself, and not a foreign organism, it might not be found difficult to trace a connexion between the so-called "gonidia" and the "spiral filaments." Thus *Chara*, in some forms, would then be an animal, and in others a vegetable, according to the distinction between it and *Amoeba*, which will presently be mentioned; for the rhizopodous cells do not produce the "gonidia" or monads until they have enclosed a portion of the cell-contents, after the manner of *Amoeba* when taking its food. Again, I have already shown how the nucleus of the latter divides up into granules and cells producing new beings, and how it becomes lost in the development of the ovules*, and Stein has shown that the nucleus of *Vorticella* becomes divided up into cells to produce a new litter; also, that it shrinks into a small elliptical effete mass of fine granules in the development of *Acinetæ* through the *Acineta*-form, which I have frequently been able to confirm. So that, if the nucleus in *Amoeba* and *Vorticella* be identical with that of *Chara*, we shall probably not be far wrong in assigning a generative power to it generally; that is, through duplication in common reproduction and by multiple division in the true process of generation. We must therefore, if we adopt these views, regard the nucleus of the *globule* as merely a modification of that of the cells of *Chara* generally, to meet the requirements of the case; and hence as a subordinate organ, which, together with the other parts of the protoplasm, is subject to a common developmental power. It has already been stated, that the nucleus perishes as soon as its functions cease, while the cell to which it belonged goes on growing. Thus the internode of the large *Nitella* of Bombay†, which may be half a foot long, loses its nucleus, probably when, as a cell, it does not exceed the 100th part of an inch, for the nucleus disappears long before the layer of green-cells is formed.

It has not, however, been shown what becomes of the small nucleoli of the effete nucleus; and perhaps it would be as well, not to assume that no more new cells can be formed after this takes place; for, if the cortical layer of cells is ever added to the first internodes and branches of the young plant of *Chara verticillata*, which I have already stated to commence in the simple form of *Nitella*, it must be some time after the nucleus has ceased to

* Ann. and Mag. Nat. Hist. vol. xviii. p. 222.

† *Idem*, vol. xvii. p. 102, foot-note.

appear in its ordinary form or as a whole; for at present I have a dozen plants with the *nucules* attached to them respectively, and each plant about one-third of an inch in length, without the least appearance of cortical cells, although each is composed of three or four internodes and several branches; if the cortical cells appear hereafter, they may, perhaps, be formed like the other cells, viz. by projections of the mother cell-wall, in the form of grooves, which, lodging a portion of protoplasm, are ultimately cut off from the parent cell or internode; in which case they must be provided with nuclei from the remnants of the old nucleolus, or nuclei altogether *de novo*.

While the component parts of the first cell of the root of *Chara* are still fresh in the mind of the reader, it seems advisable that they should be compared with those of *Amæba*. *Chara* lives by nutriment obtained through endosmosis; *Amæba*, by taking in the crude material direct, and, having abstracted the nutritious parts by the process of digestion, ultimately throwing off the refuse. *Chara* is a vegetable, though there are animal cells which also live by endosmosis; but *Amæba* cannot be a vegetable, if we admit the distinction that I have given, viz. the taking in of crude material. Nevertheless the root-cell of *Chara* and *Amæba* greatly resemble each other.

Thus the cell-wall of the former corresponds with the pellicular secretion or capsule of *Amæba*, which, in *Arcella*, &c., appears as a shell. The protoplasmic sac may correspond with the pellicula itself and diaphane. The nucleus is identical, and situated in the fixed portion of the protoplasm, as it appears in the fixed molecular sarcode of *Amæba*, when the latter assumes a spherical form. [In my Notes on the Organization of the Infusoria*, I have called the "nuclear utricle" the "capsule," and the "nucleolus" the "nucleus."] The "granules" of the fixed protoplasm have exactly the same greenish tint and appearance that the "granules" of the sarcode in *Amæba* present, and the former appear to be vicarious in function, if not homologous with the green-cell of the plant-stem; that is, when the former make their appearance, the latter disappear. The rotating protoplasm corresponds with the internal mucus of *Amæba*, to which I would confine the term "sarcodet," and the vacuoles with the vesicula and vacuoles of the substance of *Amæba*; hence it would appear that, as a cavity is formed in the protoplasm of the cell of *Chara* by the bursting of the vacuoles into each other, round which the rotating protoplasm turns, so it may be the vesicula which thus becomes distended in *Amæba* to render it spherical, and hence the appearance of the fixed sarcode on the

* Ann. and Mag. Nat. Hist. vol. xvii. p. 356.

† *Idem*. See the definition of these terms.

side of it in which the nucleus is imbedded. That the vesicula, when greatly distended, does render some of the Infusoria spherical, may easily be seen by the state in which *Plasconia* and *Vorticella* burst from their cysts respectively when the vesicula is expanded to the utmost to produce the rent, and then subsiding after the animalcule has effected its escape, thus allows of its returning to its natural form; and it is not unreasonable to infer that the same thing takes place in *Amœba*, to render its plane form spherical, and *vice versa**. Nor should we omit in this analogy the vacuolation which takes place in the protoplasm of *Chara* just before the cell dies, or when it is weakened by disease or injury, which is a common occurrence in the vesicula and its vacuolar system in *Amœba* and other Infusoria under similar circumstances.

The most interesting point, however, which this analogy brings forth is the correspondence between the rotatory motion of the protoplasm in the cell of *Chara*, and that of the sarcode of *Amœba* and other Infusoria; since, by considering this motion in different organisms, we may perhaps arrive at some notion of the cause by which it is produced in all. In the Planariæ and Rotatoria, the lash of cilia, which projects from the hepatic cells that line the stomachs of these animalcules respectively, appears to rotate the food during the process of digestion; but in the second part of the alimentary canal of the Rotatoria, where there are no hepatic cells, the surface is seen, on the approach of anything into it, to be covered with cilia. Again, in *Vorticella* and *Paramecium Aurelia*, the digestive globules also are slowly circulated round the abdominal cavity, if I may so term it, in the midst of the sarcode or internal mucus; and when we watch this circulation narrowly, for instance, in the posterior part of *Vaginicola crystallina* (Ehr.), we see that the bodies in which the chief motion exists are very minute and apparently stationary, and that, while their movements are very rapid, the circulation of the pellets of food is very slow; hence they would appear to be cilia. The same kind of circulation occurs in *Amœba*, but is so tardy, and this Infusorium is so incessantly changing its shape, that it is not seen, under ordinary circumstances. The movement of the rotating protoplasm in the Characæ is also very slow; for, when it is viewed in the long internodes of *Nitella* with a very low power, or even with the naked eye, it seems hardly to move faster than the foot of a Gasteropod; still there is no positive evidence that it moves round the cell after the manner of the latter, although it would appear to possess the power of movement *per se*. Hence the question remains undecided, viz. whether it moves round the cell by itself, or by the aid of

* *Idem*. See remarks on this point, vol. xviii. p. 131.

cilia disposed on the inner surface of the protoplasmic sac, in like manner to those which appear to exist in the abdominal cavity of *Vaginicola crystallina*, and which have been seen and drawn by the Hon. and Rev. S. G. Osborne, and confirmed by Mr. Jabez Hogg, in *Closterium Lunula**.

By the latter observation I do not mean it to be inferred, that I think the backward and forward, &c. motions of the corpuscles of *Closterium*, *Surirella splendida* (Ehr.), and *Spirogyra*, are, altogether, thus produced; for in the two latter organisms they seem to be borne along in or upon minute mucus-threads which creep over the internal surface of the primordial utricle, or stretch across to the suspended nucleus. In the terminal cells of the filaments of *Spirogyra*, especially, the advancing point of these threads may often be seen, as well as the end of the line of molecules trailing after them; and several such threads may also be seen in motion *en masse*, indicative of the whole of the internal part of the primordial utricle being composed of them, unless they form a particular structure of themselves. It has lately struck me too, while watching *Surirella splendida*, that the motion which is seen in the corpuscles of its interior is precisely similar to that of foreign bodies over its surface, which I have endeavoured to prove by analogy to depend, in the *Diatomeæ* generally, on the presence of a transparent envelope endowed with locomotive and prehensile power†.

It might be said, perhaps, by some, that in the present state of our knowledge, the comparison between a plant and an animal is not allowable; but the answer to this respecting *Amœba* is, that there is nothing on the animal side of this organism that offers for comparison equal to the organisms on its vegetable side, taking it even generally or particularly. Again, it might be said that I was formerly of opinion that the rotating protoplasm circulated round the cell by itself; but I was then not aware of the existence of the protoplasmic sac or a fixed membrane inside the root-cell, on the apparent absence of which this view was chiefly grounded. Lastly, it might be said that I formerly tried to prove that the "gonidia" developed from the Rhizopodous cells of the protoplasm were the offspring of a parasite, and now I have hinted that they may be found to be developments of *Chara* itself. Proof of the latter, however, is very remote; but when we find that there exists an intimate analogy between the nucleus of the cell of *Chara* and that of this Rhizopodous cell, as well as that of *Amœba*, &c., both in form and, probably, office, and that the nucleus of the Rhizopodous cell divides up into granules for the production of the "gonidia"

* Quart. Journ. Microscop. Sci. vol. ii. p. 234, 1854.

† Ann. and Mag. Nat. Hist. vol. xviii.

or monads,—it does not seem to me an unpardonable amount of speculation to think for a moment that the nuclei of this organism, which exist free and in their proper cells in the protoplasm of the internode of *Chara*, may be derived from those into which the nucleolus of *Chara* ultimately becomes resolved.

P.S.—In addition to the information already afforded me respecting the time which the *nucule* of *Chara verticillata* takes to germinate*, I have now to offer the following:—

On each occasion upwards of 200 *nucules* were placed in water, in watch-glasses, in a drawer with a glass-cover, close to a window, and only received the sun from about 2 P.M. to 4½ P.M. daily.

Those placed in water on the 3rd March 1856 began to germinate on the 17th day; those on the 3rd April, not until the 65th day; those on the 15th May, partially (6) on the 23rd day, and then stopping, germinated generally on the 56th day; those on the 29th June, partially (3) on the 18th day, and then stopping, germinated generally on the 41st day.

EXPLANATION OF PLATE III.

Fig. 1. Vertical section of the *nucule*, plant-stem and root-cell of *Chara verticillata*: (a) cavity of the *nucule*; (b) first cell of the plant-stem; (c) dotted line showing the original summit of this cell; (d) first internode; (e) annular groove or projection of first cell to form first node; (f) dotted line showing original form of root-cell; (g, g) two root-buds after 4-division of root-cell.

Fig. 2. Free extremity of first root-cell: (a) cell-wall; (b, b) molecular "fixed protoplasm;" (c) "rotating protoplasm;" (d) nucleus with single hyaline vacuole; (e, e, e) "irregularly shaped bodies;" (f) "granules."

N.B.—The arrow in all indicates the presence of axial fluid and the rotating protoplasm.

Fig. 3. Ditto, with second root-cell, and projection for rootlet-cell (lateral view): (d) primary nucleus elongated, hyaline vacuole in plurality; (e, e) "irregularly shaped bodies;" (f) "granules;" (g) oblique, sigmoid septum, between the first and second root-cells; (h) projection for rootlet-cell; (i) vacuoles commencing to break down fixed protoplasm of first root-cell; (k) secondary nucleus.

N.B.—The reader here, as well as in the following diagrams (which are delineated as nearly after nature as possible), must supply the intermediate ones, that is, where the nucleus has temporarily disappeared and returns with double nucleoli, &c., from the descriptions in the text. The dark granular shade in all, is intended to represent the fixed protoplasm; and the letters have not been repeated after the first figure, as the parts are sufficiently recognizable to render this unnecessary.

* Ann. and Mag. Nat. Hist. vol. xvii. p. 123.

- Fig. 4.** Ditto, with second root-cell and rootlet-cell formed (lateral view): (*d*) primary nucleus received into the dilatation of the cell-wall, *d'*, and rendered stationary; (*g*) oblique, sigmoid septum; (*k*) rootlet-cell; (*l*) secondary nucleus, elongated, presenting the hyaline vacuole in plurality; (*l*) nucleus of rootlet-cell. The remaining fixed protoplasm of the first root-cell having now been broken down by the vacuoles, circulates freely, with the rotating protoplasm, over the septum of the second root-cell and that of the rootlet-cell.
- Fig. 5.** Ditto, ditto, with first or duplicating septum of rootlet-cell formed, and multiple division of primary nucleolus (direct view): (*d*) primary nucleus with nucleolus divided into smaller nucleoli; (*m*) vacuoles beginning to break down fixed protoplasm in the lower part of second root-cell; (*n*) septum duplicating rootlet-cell; (*o*, *o*) nuclei of rootlet-cells; (*p*) lower extremity of second root-cell which is partly behind rootlet-cell.
- Fig. 6.** Ditto, ditto, with rootlet-cell quadrisected, and primary nucleus become effete (direct view): (*d*) effete nucleus from which the small nucleoli have disappeared; (*q*, *q*, *q*, *q*) nuclei of rootlet-cells; (*s*) second septum of rootlet-cell; (*t*) lower part of fixed protoplasm in second root-cell broken down and become rotatory. This cell is now brought into the state of figure 2.
- Fig. 7.** More magnified view of primary nucleus when young, 1-300th of an inch in diameter: (*a*) nuclear utricle; (*b*) mucus occupying its interior; (*c*) nucleolus; (*d*) hyaline vacuole.
- Fig. 8.** Ditto of primary nucleus when old; hyaline vacuole in plurality.
- Fig. 9.** Secondary nucleus soon after becoming visible; presenting double nucleoli.
- Fig. 10.** Ditto, some time after this, with nucleoli united. The next stage is represented in fig. 7 and so on.
- Fig. 11.** Nucleus with double nucleoli, presenting a transparent ring round them respectively, indicative of the presence of a capsule.
- Fig. 12.** Lateral view of primary nucleus after having become stationary, presenting (*a*) vacuoles in its interior.
- Fig. 13.** Elongated sac-like form of primary nucleus after having become stationary; presenting small nucleoli also elongated (*a*, *a*, *a*). This sac, which is a frequent termination of the nuclear utricle, is sometimes very long, and more or less irregular in form than the figure.
- Fig. 14.** Globular cells connected with the "irregularly shaped bodies" (*e*, *e*); sometimes seen without the latter: (*a*) common form of this "body."
- Fig. 15.** "Granules" much magnified: (*a*) round, elliptical, greenish; (*b*) angular, colourless.

III.—On two species of Echinodermata new to the Fauna of Great Britain. By L. BARRETT, F.G.S.

[With a Plate.]

THE two following species are interesting additions to our fauna, made by Mr. M'Andrew. The *Amphidotus* agrees with the brief description of *A. gibbosus*, Agass., in the Ann. Sc. Nat. t. viii. p. 11: the *Comatula* is new.

Comatula Woodwardii. Pl. VII. fig. 1.

Arms long and tapering, each ray bearing from 60 to 70 pinnæ on each side. The two pinnæ nearest the disk have each 27 joints; the third and those above it, 18. Each pinna is separated by two joints. The larger filiform processes are composed of 45 joints, gradually tapering, terminated by a claw which is larger than the joint next to it. Two specimens from the Sound of Skye, 25 to 40 fathoms, gravel and mud. I have dedicated this species to my friend S. P. Woodward, Esq.

Amphidotus gibbosus, Agass. Pl. VII. fig. 2 a, b, c.

Amphidotus gibbosus, Agass., Catalogue Raisonné des Echinides, in the Annales des Sciences Naturelles, vol. viii. p. 11.

Test cordate, as broad as long, thickly clothed with curved spines pointing towards the vent. The spines of the post-oral space have slightly flattened tips. The anterior and posterior lateral ambulacra meet at the lateral angles of the dorsal fasciole. In each of the anterior halves of the anterior lateral ambulacra there are eight very distinct pairs of pores lodged in a shallow groove; in the posterior halves of the same ambulacra there are fourteen pairs in a somewhat deeper groove. The number of pores in each row of the posterior ambulacra is equal, eleven in each series. The odd ambulacrum is covered with fine granules; the pores are not distinct, and there is no anterior groove as in *A. cordatus*. The anus is depressed, and the subanal impression quadrate, enclosing two pores on each side. The mouth is large, and placed one-third of the length of the test from the margin. The single specimen above described was dredged in 25 fathoms on the south side of Bressa Island, Zetland, on a coarse sandy bottom. It is with some hesitation that we refer this species to the *A. gibbosus* of Agass., the original description being very short and imperfect.

EXPLANATION OF PLATE VII.

Fig. 1. *Comatula Woodwardii*, nobis, nat. size.

Fig. 2 a, b, c. *Amphidotus gibbosus*, Agass., nat. size.

IV.—Notes on the Permian System of the Counties of Durham and Northumberland. By RICHARD HOWSE, South Shields.

[With a Plate.]

SINCE I had the pleasure in 1848 of drawing up a Catalogue of the fossils of the Permian System, collected by myself in the counties of Durham and Northumberland, at the request and
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for the use of the Committee of the Tyneside Naturalists' Field Club, I have on every convenient opportunity been engaged in prosecuting the same studies both in the cabinet and in the field. The works that have appeared since, by Dr. Geinitz and Mr. King, have also been subjected to a very careful examination. By the assistance of fresh specimens and a careful examination of old and new sections, I am enabled to correct many important inaccuracies which the latter author has made, and also to rectify some of my own earlier statements.

That the distribution of the fossils of this system may be better understood, I have drawn up the following account of the stratigraphical order of these rocks, from notes and sections collected during the last fifteen years. All the most important sections were revisited last autumn, to prevent as far as possible any mistake.

PERMIAN SYSTEM.

1. Lower Bunter ?

A deposit of reddish sandstone appears in two or three places in the south-easternmost part of the county of Durham. It is however generally so completely covered up with alluvium as to admit of very imperfect examination, and its fossils are entirely unknown.

Loc. Seaton-Carew, Preston-on-Tees, Coatham-Stob.

2. Magnesian Limestone.

UPPER.

1. UPPER YELLOW LIMESTONE.—A deposit of yellow, earthy, friable, thin-bedded limestone, with occasional beds of fine-grained and of oolitic structure.

Probable thickness 100 feet.

CHARACTERISTIC FOSSILS.—*Myalina squamosa*, Sow. ; *Myoconcha costata*, Brown ; *Azinus obscurus*, Sow. ; *Littorina helicina*, Schloth.

Loc. Roker, Sunderland, Hartlepool.

2. CONGLOBATED LIMESTONE.—This division consists of beds chiefly of a spheroidal, botryoidal, finely-laminated, close-grained and highly crystalline structure, interstratified with close-bedded, compact layers, and others which are earthy, friable, and pulverulent. The lower beds are occasionally much contorted and broken up by intrusive brecciated masses.

Thickness probably more than 150 feet.

CHAR. FOSS.—*Myalina squamosa*, Sow. ; *Myoconcha costata* ; *Azinus obscurus*, Sow. ; *Leda spehncaria*, Geinitz ; *Littorina*

helicina, Schloth. Numerous *Entomostraca* and *Foraminifera*. Also the remains of *Palæonisci*, &c.

Loc. Coast of Durham from Marsden Bay to Roker, between Hendon and Ryhope, and between Seaham and Black Halls; Cleadon Hills, Fulwell Hill, Building Hill, &c.

MIDDLE.

8. CONCRETIONARY AND SHELL LIMESTONE.—An amorphous irregular deposit of highly crystalline or saccharine limestone, occasionally full of small, irregular cavities, partially or entirely filled with a fine earthy yellowish powdery substance; other parts present the appearance of being formed of shapeless fragments of compact limestone imbedded in a completely investing matrix, without taking the form of a true breccia. Occasionally, however, large angular masses of finely laminated limestone are imbedded in it, especially towards its highest portion, where it also gradually becomes more earthy, and in some localities regularly bedded.

Its thickness is probably more than 150 feet.

Without fossils.

Loc. Tynemouth, North Point to Marsden Bay; coast between Ryhope, Seaham, and Castle Eden-dene; banks of the Wear above Sunderland Bridge; Tunstall Hoop.

The Shell Limestone forming the westernmost or bassetting portion of the above deposit is an irregular mass of highly crystalline limestone, in some parts exceedingly hard and fine-grained, and in others friable, earthy and rubbly, consisting of broken pieces of coral and shells. It contains an assemblage of the most characteristic fossils of the system. When seen in section it generally rests on the compact limestone, but at Clack's Heugh it rests also on a bed of incoherent sand.

The thickness, owing perhaps to denudation, is not more than 50 feet.

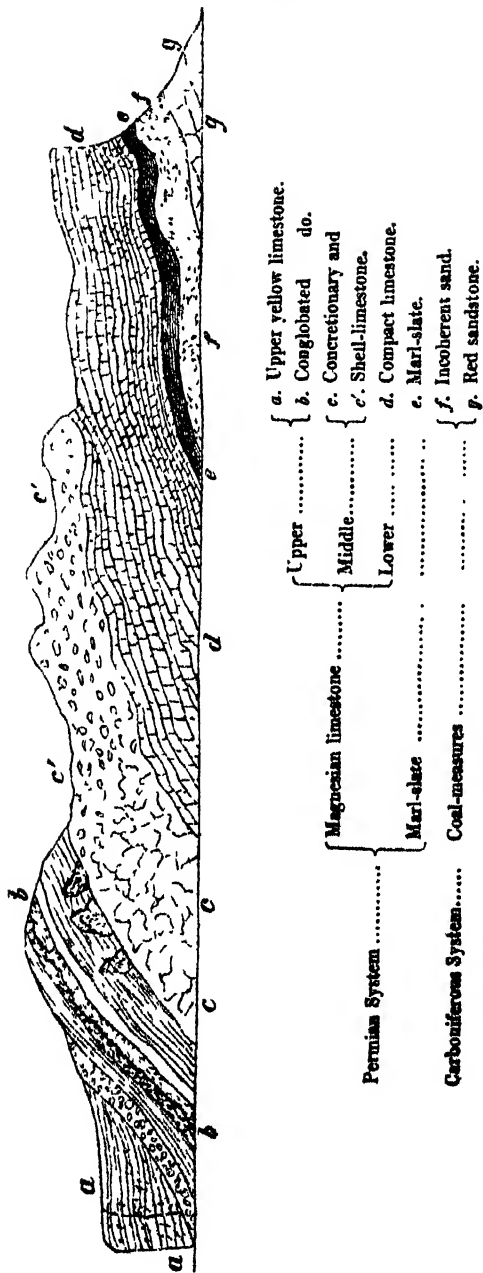
CHAR. FOSS.—*Terebratula elongata*, Schloth.; *Camarophoria Schlotheimi*, v. Buch; *Spirifer undulatus*, Sow.; *Strophalosia Goldfussi*, Müntz.; *Productus horridus*, Sow.; *Fenestella retiformis*, Schloth.; *F. virgulacea*, Phill., &c. &c.

Loc. West Boldon, Hylton Castle, Southwick Red House, Clack's Heugh, all on the escarpment. High Barns, Humbleton Hill, Elstobs, Tunstall Hill, Ryhope Field House, Dalton-le-dale, Castle Eden-dene. These places are situated on the middle portions of the Magnesian Limestone.

LOWER.

4. COMPACT LIMESTONE AND CONGLOMERATE.—In most places on the escarpment the compact limestone forms a very thick

Ideal Section across the Magnesian Limestone Terrace.



deposit of thin-bedded, compact, bluish, grey or mottled limestone, becoming occasionally brown, earthy, cellular, and with thicker beds towards the top.

It attains a thickness probably of 150 to 200 feet.

CHAR. FOSS.—Same as in shell-limestone, but not so abundant.

Loc. Whitley, Cullercoats, Tynemouth, outliers; from North Point to Man Haven, surmounted by concretionary limestone; Westoe, West Boldon, Hylton Castle, Clack's Heugh, Pallion, Mill Field, Humbleton, Tunstall Hope, Painshaw Hill, and most other parts of the escarpment to Pierce Bridge.

The Conglomerate is a very local deposit of rounded fragments of compact limestone imbedded in a limestone matrix. It is of inconsiderable thickness, and passes into the associated compact limestone.

CHAR. FOSS.—Same as in compact limestone.

Loc. Tynemouth; Black Halls? Houghton-le-side?

3. Marl Slate.

The Marl-slate is a very thin deposit, seldom exceeding a yard in thickness, of a dark grey, or yellowish, finely laminated marl.

CHAR. FOSS.—*Palæonisci*, *Platysomi*, and other fishes; *Discina Konincki*, Gein.; *Lingula Credneri*, Gein.; *Cuulerpites selaginoides*, Schloth., and other fucoids.

Loc. Cullercoats, Tynemouth, Westoe, West Boldon, Clack's Heugh, and most other places on the escarpment.

GENERAL REMARKS.

The foregoing divisions include all the beds which can be with safety referred to, and satisfactorily determined to belong to the Permian System as developed in the counties of Durham and Northumberland. But it has hitherto been the custom of English geologists to consider an extensive bed of incoherent yellow sand and red sandstone lying immediately beneath these, as members of the same system, and to separate them by a distinctive name from the subjacent coal-measures, with which they are perfectly conformable, and, so far as the red sandstone is concerned, identical in fossil contents. At Cullercoats and Tynemouth the red sandstone is so evidently conformable, and passes so gradually into the shales and sandstones of the true coal-measures, that it is impossible to separate them, or point out a line of separation. The same arrangement also is seen on the banks of the Wear, near Clack's Heugh, where both these beds are seen dipping at the same angle as the coal-measures.

The incoherent yellow sand is present at almost all places along the escarpment of the limestone, but it varies considerably in thickness. It is very coarse and gritty, with strong lines of false bedding; and from its variable thickness within short distances, the superior magnesian limestone must be unconformable to it.

The Red Sandstone, usually pointed out as the equivalent of the *Roth-liegende*, contains at Tynemouth and other localities an assemblage of genuine coal-measure fossils. During the last summer we obtained from the cuttings made for the new pier at Tynemouth the following species: viz. *Pinites Brandlingi*, *Trigonocarbon Nöggerathi*, *Sigillaria reniformis*, *Lepidodendron*, sp. indet., *Calamites approximatus*, *Calamites inequalis*?; and in the shale immediately connected with the sandstone, *Neuropteris gigantea*, *Sphenopteris latifolia*, *Cyclopteris dilatata*, &c. The spine of *Gyracanthus formosus* has been found in the same bed near South Shields. In consequence of the presence of so many genuine coal-plants in this bed, its conformity to the coal-measures, and the apparent want of conformity between the incoherent sand and the superior limestone, we propose that these beds may for the future be considered true coal-measures, and the uppermost members of the Carboniferous System.

In the above divisions, the names given originally by Prof. Sedgwick have been adopted as far as possible. The terms *Pseudo-brecciated*, *Brecciated*, and *Crystalline*, are not admissible as divisional names. The former is the Concretionary limestone (Sedgw.), which is a more correct epithet than the proposed new name. The Breccia is too subordinate in the series to require a particular name, and the limestones of this series are all too crystalline to admit of this word as a distinctive term.

The following Table will give a pretty correct idea of the distribution of the Molluscan Fauna of the Permian System. The Brachiopoda are limited to the lower portions of the series,—to the marl-slate, compact limestone, and shell-limestone. There is no authenticated instance of the occurrence of a Brachiopod in the breccia or above it. The greatest number of Gastropoda are found in the middle division, the shell-limestone. Four species of Conchifera appear to be common to the whole limestone series: viz. *Myoconcha costata*, Brown; *Axinus obscurus*, Sow.; *Myalina squamosa*, Sow.; and *Leda Vinti*, King.

The works principally referred to in the following Table were published at the time mentioned below: viz.

'Die Versteinerungen,' April 1848.

'Trans. Tyneside N. F. C.' Aug. 10th, 1848.

'A Cat. of Org. Rem.' Aug. 19th, 1848.

'Mon. Perm. Foss.' 1850.

Synoptical Table of the MOLLUSCA of the Permian System of Durham and Northumberland.

No. of Species.	Genus and Species.	Authors.	References.	Synonyms.	Localities.	Marl-shale.	Compact.	Conglomerate.	Mgbl.-limestone.	(Concretionary.	Conchoidal.	Upper yellow.	Lower Bunter.
1.	BRACHIOPODA. <i>Lingula Credneri</i> ...	Geinitz	Versteinerungen, p. 11. tab. 4. f. 23, 24.	<i>L. mytiloides</i> ? Trans. T. N. F. C. vol. 1. p. 250.	Thursington Gap, Ferry Hill	*	*	*	*				
2.	<i>Dicyna Koninek</i> ...	Geinitz	<i>O. Koniecki</i> , Grun. d. Verst. p. 495; Verst. tab. 4. f. 25, 26.	<i>Orbicula</i> , Trans. T. N. F. C. vol. 1. p. 251. <i>Dicyna speluncaria</i> , Mon. pl. 6. figs. 28, 29.	Thursington Gap, Gar-mundaway, Tun-stall Hill, Humbleton Hill.	*	*	*	*				
3.	<i>Productus horridus</i>	Sow. ...	Min. Conch. tab. 319. f. 1 ..	<i>Orthothrix excavatus</i> , Verst. tab. 6. f. 21.	North Point near Shields, Westoe. Hyton Castle, &c. &c.	*	*	*	*				
4.	— <i>latirostratus</i>	Howse	Trans. T. N. F. C. vol. i. pp. 256-7; Ann. Nat. Hist. 2nd ser. vol. xix. pl. IV. figs. 1, 2.	<i>P. subovalatus</i> , King, Cat. p. 8; Mon. pl. 11. fig. 14-16; Schuchroth. Ein Beitr. u. s. w. tab. 1. f. 8-10.	Tunstall Hill, Dalton-le-dale, Ryhope Field House.	*	*	*	*				
5.	<i>Strophalosia Goldfussi</i>	Münst.	<i>Spondylus</i> id., Beitrage, vol. 1. pl. 4. f. 3 a, b; Davidson, Mon. Brit. Peru. Brach. pl. 3. figs. 1-23. <i>Orthothrix Goldfussi</i> , Verst. tab. 5. f. 27-30. 32, 34. <i>Stroph. id.</i> , Mon. pl. 12. f. 1-12.	<i>P. Morrisiana</i> et <i>P. asperius</i> , Trans. T. N. F. C. vol. 1. p. 257. <i>Orthothrix excavatus</i> , Gein. Verst. tab. 5. f. 35-40, tab. 6. f. 20, 23. <i>Stroph. excavata</i> , Mon. pl. 12. f. 13-17. <i>Stroph. Morrisiana</i> , Mon. pl. 12. f. 26? <i>Stroph. parva</i> , Mon. pl. 12. f. 33. <i>Stroph. excavata</i> , var. <i>Whiteleyensis</i> , King, Ann. N. H. vol. xvii. p. 268.	Clack's Heugh, Humbleton Hill, Tunstall Hill, Ryhope Field House, Dalton-le-dale, Gar-mundaway, &c.	*	*	*	*				
6.	— <i>Caucrini</i> ...	De Vern.	Geol. Russ. vol. ii. pl. 16. f. 8, pl. 18. f. 7; Davidson, Mon. Brit. Peru. Brach. pl. 3. f. 24-41.	<i>O. Goldfussi</i> , Verst. tab. 5. figs. 31, 33 a, b, c. <i>Prod. Caucrisi</i> , Verst. tab. 6. figs. 16-19. <i>Strophalosia Morrisiana</i> , King, Cat. p. 9; Mon. pl. 12. f. 18-25, 29-32. <i>O. lamellosa</i> , Geinils, Verst. tab. 5. f. 16-26.	Westoe, Clack's Heugh, Humbleton Hill, Tunstall Hill, Ryhope Field House, Dalton-le-dale, &c.	*	*	*	*				

No of Species	Genera and Species	Authors.	References	Synonyms	Localities.	Magnesian Limestone					Lower Bunter	
						Beal-shale		Compall.	(conglomerate.)	Whell-limestone		(concretionary)	(conglomerated)	Upper yellow
7	BRACHIOPODA (cont.) <i>Orthisina pelargonata</i>	Schloth	<i>Terebratulites</i> <i>ad.</i> , Beatr. 2 Naturg. d. Verst. p. 23 tab. 8 f. 21-24		Humbleton Hill, Tun- stall Hill, Silkworth, Ryhope Field House, Dalton-le-dale.	*						
8	<i>Cammarophoria</i> Schlot- heim.	v. Buch	über Terebrateln. pl. 2. f. 32	<i>Terebratula superstes</i> , Geun. Verst. tab. 4. f. 51, 52	Tynemouth, Hylton Castle, Humbleton, Tunstall, Silkworth, Ryhope, Dalton-le- dale.	*						
9	— <i>globulosa</i>	Phill.	Ency. Metrop. vol. iv. pl. 3. f. 3	<i>Tyr. corymbosa</i> (errat.), Trans. T. N. F. C. vol. i. p. 253. <i>T. S. Motherm.</i> Schaur. Beatr. pl. 1 f. 3 a, b.	Tynemouth, Hylton Castle, Dalton-le-dale, &c.	*						
10	— <i>Humbletonensis</i>	Howse	<i>Terebratula</i> <i>ad.</i> , Trans. T. N. F. C. vol. i. p. 252, Ann. N. H. ser. 2. vol. xix. Pl. IV. f. 3, 4	<i>C. multiplicata</i> , King. Cat. p. 7, Mon. pl. 7 f. 26-32, pl. 8. f. 1, 2	Tynemouth, Humble- ton.	*						
11.	<i>Spurigera pectinifera</i>	Sow.	<i>Atrypa</i> <i>ad.</i> , Min. Conch. vii. pl. 616		Tynemouth, Hylton Castle, Humbleton Hill, Tunstall Hill.	*						
12	<i>Martunia Clannysana</i>	King	Cat. p. 8; Mon. pl. 10. f. 11, 12, 13.	<i>M. Wischusana</i> , King, Mon. pl. 10. f. 14, 15, 16, 17.	Whitley, Pallion near Sunderland, Ryhope Field House, Tunstall, Humbleton, Tunstall, Ryhope Field House.	*						
13	<i>Spuriferina cristata</i>	Schloth.	<i>Terebratulites</i> <i>ad.</i> , Beatr. 2 Naturg. d. Verst. p. 23 tab. 1. f. 3; Ann. Nat. Hist. ser. 2. vol. xix. Pl. IV. f. 5, 6.		Humbleton, Tunstall, Silkworth, Ryhope, Dalton-le-dale.	*						
14.	— <i>multiplicata</i>	Sow.	Geol. Tr. 2nd ser. iii. p. 119	<i>Tyrig Jonesana</i> , King, Mon. pl. 8 f. 19.	Tynemouth, Humble- ton, Tunstall, Middle- ton ridge.	*						
15.	<i>Spurifer undulatus</i> ...	Sow.	Min. Conch. tab. 563. f. 1	<i>Tyrig. alata</i> , King, Mon. pl. 9. f. 4- 12. <i>Tyrig Permianus</i> , King, Mon. pl. 9 f. 18, 24		*						

16. <i>Trochostylus elongatus</i> ...	Schloth.	Beitr. z. Naturg. d. Verst. p. 27. f. 1-9.	<i>Epithyrus sufflata</i> , King, Mon. pl. 7.	Tynemouth, Hylton Castle, Clack's Heugh, Humbleton, &c. &c.	*	*	*
17. <i>Pecten pusillus</i> ...	Schloth.	Beitr. z. Naturg. d. Verst. p. 31. tab. 6. f. 6.		Tunstall, Humbleton, Silksworth, Ryhope, Dalton.	*	*	*
18. <i>Leda permiana</i> ...	King	Mon. pl. 13. f. 4.		Tunstall, Ryhope, Humbleton.	*	*	*
19. <i>Monotis apulonearis</i> ...	Schloth.	<i>Gryphites id.</i> , Beitr. z. Naturg. d. Verst. p. 30. tab. 5. f. 1.	<i>Monotis gryphaeoides</i> , Trans. T. N. F. C. vol. i. p. 249. <i>M. radiata</i> , Phill., King, Mon. pl. 13. f. 22, 23. <i>M. Garforthensis</i> , King, Mon. pl. 13. f. 24. <i>M. —</i> ? Mon. pl. 13. f. 25. <i>Aric. Kazanensis</i> , Geol. Verst. tab. 4. f. 20, 21.	Tynemouth, Clack's Heugh, Hylton Castle, Humbleton, Tunstall, Ryhope, Dalton-le-dale, &c.	*	*	*
20. <i>Gerrillia antiqua</i> ...	Münst.	Goldf. Petref. pl. 116. f. 7.	<i>Aric. inflata</i> , Trans. T. N. F. C. vol. i. p. 250. <i>Bakereilia tumida</i> , King, Cat. p. 10; Mon. pl. 14. figs. 35, 36, 37.	Whitley, Tynemouth, Clack's Heugh, Hylton Castle, Humbleton, Tunstall, Ryhope, Dalton-le-dale, &c.	*	*	*
21. <i>Myalina squamosa</i> ...	Schloth.	Beitr. z. Naturg. d. Verst. p. 30. tab. 5. f. 2.	<i>Bakereilia Sedgwickiana</i> , King, Mon. pl. 14. f. 38, 39, 40. <i>B. bicarinata</i> , King, Mon. pl. 14. f. 41, 42.	Humbleton, Tunstall.	*	*	*
22. <i>Macrondon striata</i> ...	Sow.	Geol. Trans. 2nd ser. iii. p. 120. no. 11. <i>Mytilus acuminatus</i> , Sow. Geol. Trans. 2nd ser. iii. p. 119. no. 10.	<i>Myt. acuminatus</i> , Trans. T. N. F. C. vol. i. p. 248. <i>Myt. Hausmanni</i> , Geol. Verst. tab. 4. figs. 9, 10, 11. <i>Myt. squamosa</i> , Marsden, 12, 13, 14, 15. <i>Myt. squamosa</i> , Trans. T. N. F. C. vol. i. p. 248. <i>Myt. septifer</i> , King, Mon. pl. 14. f. 8-13.	Hylton Castle, Clack's Heugh, Humbleton, Tunstall, Silksworth, Ryhope, Dalton, Marsden, Cleadon Hills, Byer's Quarry, Roker, &c. &c.	*	*	*
23. <i>Leda apulonearis</i> ...	Schloth.	<i>Mytilites striatus</i> , Beitr. z. Naturg. d. Verst. p. 31. tab. 6. f. 3.	<i>Arca tumida</i> , Trans. T. N. F. C. vol. i. p. 247; Verst. tab. 4. f. 6 a, b; Mon. tab. 15. f. 1-5. <i>A. Lofthiana</i> , Trans. T. N. F. C. vol. i. p. 246. <i>A. Kingiana</i> , Trans. T. N. F. C. p. 247. <i>Byzocarca Kingiana</i> , Cat. p. 11; Mon. pl. 15. f. 10, 11, 12. <i>Arca Kingiana</i> , Verst. p. 9. pl. 4. f. 8 a, b, c. <i>Leda Fisti</i> , King, Cat. p. 11; Mon. pl. xx. f. 21, 22. <i>N. Tuticiana</i> , Mon. p. 175?	Hylton Castle, Humbleton, Tunstall, Silksworth, Ryhope Field House, Dalton-le-dale.	*	*	*
24. <i>Leda apulonearis</i> ...	Gemnitz	<i>Nucula id.</i> , Verst. p. 9. tab. 4. f. 6 a, b.		Whitley, Humbleton, Byer's Quarry, Tunstall.	*	*	*

34.	<i>Calyptra antiqua</i> ..	Howse	Trans. T. N. F. C. i. p. 242; Ann. vol. 19. ser. 2. Pl. IV. f. 16, 17.	<i>Patella Holleisii</i> , Schauroth, Einbeirag, p. 557. pl. 21. f. 8.	Tunstall	*
35.	<i>Salina symmetrica</i> ..	King	<i>Macrocheilus symmetricus</i> , King, Mon. pl. 16. f. 32, 33.	.....	Tunstall, Humbleton, Silksworth.	*
36.	<i>Chamaistaria Boeseleri</i> ..	Geinitz	<i>Lox. id.</i> , Schauroth, Beiträg, &c. p. 558. pl. 21. f. 9.	<i>Chamaistaria</i> indet., Trans. T. N. F. C. vol. i. p. 241. <i>Lox. Svedenborgiana</i> , Mon. p. 210?	Tunstall Hill	*
37.	— <i>Alkenburgensis</i> ..	Geinitz	<i>Turbosilla Alkenburgensis</i> , Gran. Verst. tab. 3. f. 9, 10; Ann. Nat. Hist. ser. 2. vol. 19. Pl. IV. f. 18.	<i>Loxosema Gemiliana</i> , King, Mon. p. 210. pl. 16. f. 31. <i>Lox. fasciata</i> , King, Mon. p. 209. pl. 16. f. 30. <i>Turrit. Phillipsi</i> , Trans. T. N. F. C. vol. i. p. 240. <i>Turrit. Tunstallensis</i> , Trans. T. N. F. C. vol. i. p. 241.	Tunstall Hill, Humbleton, Dalton-le-dale.	*
38.	<i>Littorina helicina</i>	Schloth.	<i>Trochilites id.</i> , Petrefactenkunde, p. 161, 1820; Ann. Nat. Hist. ser. 2. vol. 19. Pl. IV. f. 19, 20.	<i>Turbo Maccusiana</i> , Brown, Manch. Trans. Geol. Soc. vol. i. pl. 6. f. 1, 2, 3. <i>Turbo Taylorianus</i> , Mon. pl. 16. f. 25, 26. <i>Littorina Tunstallensis</i> , Trans. T. N. F. C. vol. i. p. 240. <i>Turbo Thompsonianus</i> , King, Mon. 16. f. 23, 24. <i>Trochus pusillus</i> , Gein. Verst. pl. 3. f. 15, 16. <i>Turbo Perminianus</i> , King, Cat. p. 13; Mon. pl. 16. f. 16.	Southwick-lane House, Humbleton, Tunstall, Clack's Heugh, Byer's Quarry near Whitburn, Roker, &c.	*
39.	— <i>Hercynica</i>	Geinitz	<i>Nat. Hercynica</i> , Gein. Verst. pl. 3. f. 11-13.	<i>Natica Liebauiana</i> , King, Cat. p. 13; Mon. pl. 16. f. 27, 28. <i>L. minima</i> , Trans. T. N. F. C. vol. i. p. 240.	Tunstall, Humbleton, Silksworth.	*
40.	<i>Pleurotomaria antrina</i>	Schloth.	<i>Troch. id.</i> , Beitr. z. Naturg. d. Verst. p. 32. t. 7. f. 6; Ann. Nat. Hist. ser. 2. vol. 19. Pl. IV. f. 21, 22, 23, 24, 25.	<i>P. Sedgwicki</i> et <i>P. penea</i> , Trans. T. N. F. C. vol. i. p. 238. <i>P. Tunstallensis</i> , Mon. pl. 17. f. 3, 4, 5. <i>P. Linkiana</i> , Mon. pl. 17. f. 7, 8. <i>Exomphalus Perminianus</i> , Mon. pl. 17. f. 10, 11, 12. <i>P. Farnesii</i> , Gein. Verst. tab. 3. f. 17, 18.	Tunstall, Hylton Castle, Humbleton, Ryhope, Dalton-le-dale, &c.	*
41.	— <i>nodulosa</i>	King	Mon. p. 216. pl. 17. f. 9.	.....	Tunstall, Humbleton	*
42.	<i>Nautilus Frieslebeni</i> ..	Geinitz	Verstein. tab. 3. f. 7a, b, c; Ann. Nat. Hist. ser. 2. vol. 19. Pl. IV. f. 26.	<i>N. Boererbanksianus</i> , King, Mon. p. 220. pl. 17. f. 17, 18, 19.	Clack's Heugh, Humbleton, Tunstall, Silksworth, Dalton-le-dale.	*
43.	<i>Theca Kirtbyi</i>	n. s.	Ann. vol. 19. ser. 2. Pl. IV. f. 27.	.....	Tunstall Hill	*

Remarks on the Species.

BRACHIOPODA.

1. *LINGULA CREDNERI*, Geinitz.—The form of this shell as it occurs in the marl-slate of Durham is a perfect oval, the breadth being about two-thirds of the length. On our specimens the roll-formed elevation is not so distinct as Geinitz represents it, but the height of the valve increases from the posterior umbonal margin to about one-third the length of the shell, whence it decreases gradually towards the front and more rapidly towards the sides. The lines of growth are strongly raised, and much wider apart in front than in any other part.

This shell is finely preserved in the marl-slate at Ferry Hill, where it is rather abundant. The largest specimen I have seen is half an inch in length and five-sixteenths in breadth, but it is generally very much less. Only one individual occurred with both valves together, and that was found in the compact limestone a few feet above the marl-slate. Along with these, numerous fragments of Fishes and specimens of *Caulerpites selaginoides* constantly occur.

I may be allowed to question the occurrence of this or any other species of *Lingula* in the underlying red sandstone, as stated in King's Monograph on the authority of Prof. Johnston, as this sandstone is a true coal-measure stratum.

2. *DISCINA KONINCKI*, Geinitz.—Very little can be added to the original description of this shell by Geinitz. The German specimens appear to be of about the same size as those occurring in England, and with the same proportions. This Brachiopod has a greater vertical range in England than any of the others, being found in the marl-slate, compact limestone, and shell-limestone; it is also the rarest.

Geinitz observes, that as "neither the drawing nor description of Schlotheim's *O. speluncaria* appears to exist, the name which Schlotheim gave to it should be suppressed." Mr. King has, however, upon Goldfuss's authority, again revived it; but until some figure of it, or some description or specimen can be shown, we have no right to adopt an apocryphal name.

3. *PRODUCTUS HORRIDUS*, Sow.—The exterior of this shell is now very generally well known through the numerous figures and descriptions of it which have from time to time been published by several authors, but the interior has up to the present period never been correctly delineated. Through the kindness of Mr. Davidson, I am, however, furnished with four proof-plates of Permian fossils, and favoured with permission to make references to them; in these the interior of this species is for the first time faithfully represented.

In the shell-limestone of Humbleton this species generally

occurs in casts, on which all the permanent structures of the interior of the shell are faithfully impressed. One can, by a study of these casts alone, restore and represent all the important characters of the interior; but in addition to these casts, one frequently finds at Tunstall the shell itself, showing the interior as perfectly preserved as in recent shells. It is therefore rather a matter of surprise that no better figures of the interior of this shell have yet been published. Mr. King figures a gutta-percha cast of the interior of one valve only, and that one, judging from the specimens that I have examined, very incorrectly, as will best be proved by comparing his figure, Mon. pl. 11. fig. 10, with Mr. Davidson's Mon., pl. 4. figs. 19, 21, and with good casts from Humbleton or interiors from Tunstall. The most incorrect part of Mr. King's restoration is the strongly granulated or obscurely dendritic appearance of the adductor muscular impressions, which are also erroneously divided into two sets; and the reniform impressions are made to take their origin in these more distinctly than is warranted by good specimens. The cardinal boss, the hinge-margin, and the spine-like callosities on the inner surface of the shell are also all very imperfectly represented. Dr. Geinitz's figures of the same valve are more correct than the one already mentioned, but the adductor muscular impressions are too leaf-like and lobed. All the other figures of this valve that have been published since 1850 appear to be merely copies from King's.

The hinge-line of the upper valve is not quite straight, but slightly angulated, the angle being strongest near the boss. The boss, or cardinal muscular fulcrum, varies slightly in form, but it is generally bifid at the extremity, each part being slit by a deep triangular groove or furrow. When *in situ* it fills nearly the whole of the umbonal cavity of the lower valve and presses against its inner surface. It may thus assist in keeping the valves in position. About the base of the boss the shell is very much thickened, and from it a strongish ridge runs along on each side parallel to the hinge-margin, which gives to the latter a bevelled appearance. On the outer side of this ridge is seen the row of depressions caused by the cardinal spines. From the base of the boss a thin plate or septum proceeds straight forwards into the cavity of the shell, becoming deeper and free in front; it separates the adductor muscular impressions and the reniform callosities, to which latter the oral arms were probably attached. The muscular impressions on this valve have each a triangular form, and as they are placed close to each side of the median plate, they have together a fan-shaped form. They are considerably raised, and most so on the anterior margin. Their surface is sculptured out into deep curved linear hollows for the attach-

ment of the muscles. The surface round about these muscles and the cardinal regions is neatly pitted, causing small pimples on the casts; these are probably the ovarian spaces. One observes similar markings on the corresponding parts of the other valve.

It is generally supposed that the reniform callosities are connected with the vascular system, but this supposition appears to be unsupported by a comparison of these processes with the corresponding parts of other Brachiopods. If we compare them, for example, with the same valve of *Argiope*, or of *Thecidium*, genera which show points of resemblance to this in several particulars, we find that these processes have served for the attachment of the oral arms; and this view is supported by all that we know of the position of these arms in both recent and fossil genera. At least, these structures cannot be attributed to the vascular system, or they would undoubtedly be present in both valves, whereas they are confined to one.

On some casts of this *Productus* a great number of small parallel grooves or furrows are seen running from the central ovarian region to the anterior margins of the valves; they are not very distinct, but they may perhaps hereafter be found to have been connected with the vascular system. This idea is somewhat strengthened by the appearance of similar lines on some casts of *Spirifer*, which few persons would hesitate to pronounce as vascular sinuses. There remain to be noticed on this small valve the curious spine-like callosities which stud the whole of the anterior portion of the shell; they are strongest where the produced, curved-up portion of the margin takes its rise, and seem to have been for the more secure attachment of the mantle and for giving it a greater surface.

In the lower valve an elevated callosity near the beak of the shell forms a fulcrum for the attachment of the adductor muscles; its surface is strongly rugose. On each side of it are placed the somewhat oblong, finely-striated impressions of the cardinal muscles. The small pittings on the ovarian regions, the spinose callosities, and grooved surface of the interior correspond with the same appearances in the upper valve.

It is found in England in the compact- and shell-limestone only, in numerous localities.

4. *PRODUCTUS LATIROSTRATUS*, Howse.—When I was engaged in drawing up my Catalogue of Permian Fossils, I found that this shell had not been described or mentioned by any one; and as I had collected several fine specimens at Dalton-le-dale, and had not seen or heard of any other specimens of it than these, I concluded that it was entirely new, and described it as such in the 'Tyneside Transactions' as follows:—

Shell gryphæoid, concavo-convex; lower valve convex, bilobed, or with a slight furrow or sinus in the centre; upper valve slightly concave, or nearly flat; beak of lower or convex valve large, and very much flattened; hinge-line of upper valve rather angulated, furnished with a large triangular button; surface of convex valve covered with a few distant spines.

The above description was drawn up from a cast, Pl. IV. fig. 2, which Mr. Davidson has recently figured, Mon. Brit. Brach. pl. 4. fig. 5, and which Mr. King had the loan of, with all my other Permian *Producti*, for a considerable time. The discovery of a large series of specimens at Tunstall in a fine state of preservation enables me, through the liberality and kindness of Mr. Kirkby, to add a few more particulars to the above description.

The general form is subquadrate, somewhat compressed when seen laterally, but in full-grown specimens it has a considerably produced frontal margin. The lower valve only is covered sparingly with spines of great length; some that I have seen extend more than two inches from the shell. The hinge-margin of this valve is very much thickened by lines of growth, so as to lead one to suppose that it is furnished with an area, but it is not. A small triangular aperture, open from the very apex, receives the sharply-pointed triangular boss of the upper valve. This sharp point leaves a little, narrow groove as the shell increases in growth. But there is no proper area, foramen, or deltidium to be seen,—nothing, in short, to warrant its removal from the genus *Productus*.

It differs from its congener in several important particulars. The boss or muscular fulcrum, the shape of the muscular impressions, the greater size of the oral arms, the absence of cardinal spines on the upper valve, the flanging of the hinge-margin of the upper valve, are so strongly characterized, that it cannot be mistaken for any other species.

Mr. King has given to this shell another name, for the priority of which he refers to his catalogue. As I shall state my claims of priority elsewhere for my catalogue, it may be permitted me to remark here, that this shell is not specifically described in Mr. King's catalogue. It occurs in the shell-limestone only, in which I have taken a fine series at Dalton, and Mr. Kirkby at Tunstall Hill.

5. *STROPHALOSIA GOLDFUSSI*, Münst.—To this characteristic but variable species I now refer all the *Strophalosia*, which have been separated into two groups by all who have written on Permian shells. I was of this opinion before I became acquainted with Geinitz's 'Versteinerungen;' but from the characters given in that work and Mr. King's Monograph, and an excellent series of these forms collected by Mr. Kirkby and myself, I am in-

duced to abandon this idea and to include both forms in one specific group.

The *Orthothrix Goldfussi* of Geinitz is the typical form. It is the *Strophalosia excavata*, King; and *Stroph. Goldfussi*, King, is without a doubt the *O. excavatus*, Geinitz, as any one may ascertain by consulting the figures and descriptions given by both these authors in the 'Versteinerungen' and 'Monograph.'

Stroph. Goldfussi, Münt., is thus characterized by Geinitz:—"Back (ventral) shell roundish oval, quite like the preceding species (*O. lamellosus*, Gein.), and also without a sinus, and covered all over the surface with close-set tubular spines and with a short but high area." The shells figured by Mr. King, Mon. tab. 12. figs. 13, 14, 15, 16, so evidently belong to the above description, that I need not quote Geinitz further to prove it. This is the form which I formerly described as *Productus asperrimus*.

Geinitz's *O. excavatus* is described as hemispherical transverse-oval, with a small, depressed, pointed umbo, a high arca, and a narrow, sometimes only weakly-marked sinus, with fine concentric striae, and studded with thin but long tubular spines. The general character, "halbkugelig quer-oval," is so expressive of the general appearance of King's *S. Goldfussi*, Mon. pl. 12. figs. 1-11, that I cannot doubt its identity with *O. excavatus*.

The regular form of this shell, 'Mon. Brit. Perm. Brach.' pl. 3. figs. 19, 20, 21, 22, therefore must be considered as the typical *S. Goldfussi*; and if it is thought desirable to distinguish the other by a varietal name, *excavata* can be applied to it. But these two forms run so much into one another, that it is impossible to draw a line of separation between them.

The principal character by which Geinitz would separate his *O. excavatus* from *O. Goldfussi* is the sinus of the ventral valve. This is not a constant character, and certainly not a specific one. Mr. King observes (Mon. p. 99),—"The arrangement of the spines constitutes a capital distinctive character for this species;" and, strangely enough, he refers to a shell doubtfully placed in *Goldfussi* by Geinitz and excluded from it by King as a proof. Now this excluded shell with the "capital distinctive characters" is nothing more than Mr. King's *S. Goldfussi*, for it is the *O. excavatus*, Gein. After all the difficulties attending the study of this species, one turns with pleasure, and for confirmation, to Mr. Davidson's excellent plate iii., and to the original *diagnosis* of this shell by N. Winch in the 'Geol. Trans.' vol. iv. p. 10, "A species of *Donax* with hair-like spines."

This species is common in the shell-limestone of Durham, and occurs also, but more sparingly, in the compact limestone, and has also a very extensive lateral range.

6. *STROPHALOSIA CANCRINI*, de Verneuil.—In England this shell is best known as King's *S. Morrisiana*, in Germany it is Geinitz's *Orthothrix lamellosus*, and in Russia it is the *Prod. Cancrini*, de Vern. It may rejoice in more epithets than these, but I am unacquainted with them. The one I have adopted is that under which it was first described. Geinitz's name is next in order, as his description and figures were published in the early part of April 1848; and Mr. King's is last, as his specific description cannot date earlier than the appearance of his Catalogue in August 1848.

This species varies so much with age and locality, and is so apt to become distorted, that no special form can be given that will include all the individuals which undoubtedly belong to it. In general, young individuals are broader than long—that is, when the shell is of regular growth,—and the greatest breadth of the shell is then very little more than that of the hinge-margin. In larger individuals the general form is almost circular, and the hinge-margin appears narrower. In distorted specimens the area is much narrower and deeper than in those of regular growth. This is very remarkable in some specimens from Tunstall. At Dalton this species resembles the form to which Geinitz has applied the name *lamellosus*. The specimens from Humbleton are much larger, and generally of regular growth. I have never been able to detect spines on the upper valve of any of the specimens from the above localities, but Mr. Kirkby has lately obtained some individuals from Ryhope with the spines distinctly shown on this valve. These specimens are also rather broader than those from other localities, and the striæ are nearly obsolete. The most striking characters common to all these forms are the long adpressed spines of the lower valve, and the strong radiating striæ which are generally present on both valves. In old individuals the front margin strikes off nearly horizontally, and forms a kind of siphonal tube in front. There is also a tendency in this species to form a new internal surface behind the old upper valve, for the purpose of contracting the interior of the shell. It is not an additional, third valve as King has supposed, for it is essentially connected with the upper valve, and must have been formed by the upper lobe of the mantle.

Most plentiful in the shell-limestone of Humbleton, Tunstall, and Dalton. In the compact limestone it is very rare.

7. *ORTHISINA PELARGONATA*, Schloth.—This neat species is not included in the list of Permian fossils of the 'Geol. Russ.' as a British species; and indeed, when I became acquainted with some of our palæontologists, I found them entirely unacquainted with it. This was remarkably the case with Mr. King, who had

not the slightest knowledge of the shell when I first showed it to him, and to whom I presented a fine series of Dalton specimens afterwards, that he might be able to illustrate the species in his 'Monograph.'

The general form of this species is now, through the figures of Geinitz and King, pretty well known, and the interiors have lately been very accurately represented by Mr. Davidson in his work on the Permian Brachiopoda, pl. 2. figs. 38-40.

Though a rare species generally, numerous examples are occasionally found in a very limited space. It is the common associate of *P. latirostratus*, both at Dalton-le-dale and Tunstall, where numerous examples have been taken by Mr. Kirkby and myself.

8. CAMAROPHORIA SCHLOTHEIMI, v. Buch.—It is very probable that some specimens figured by Verneuil in the 'Geol. Russ.' under a distinct name, *Terebratula superstes*, belong to the present species; but as I have not seen specimens of that species, I cannot settle this point. Mr. King thinks that some specimens figured by Geinitz under this name, 'Verst.' pl. 4. figs. 48, 49, belong to another species, but the figures referred to are only more plaited than usual. Similar specimens occur occasionally at Dalton, which Mr. King is inclined to refer also to our *C. Humbletonensis*; but I can say with confidence that this last species never occurs in that locality.

This most characteristic Brachiopod occurs rather plentifully in the shell-limestone of this district, and very sparingly in the compact limestone.

9. CAMAROPHORIA GLOBULINA, Phill.—This is a very distinct species, though some authors only partially acquainted with it have united it with the preceding.

Its spherical form, biplicated sinus, and the comparative smallness of the size it attains to, would be sufficient alone to separate it from all other Permian species; but in addition to these external characters, the apophysary system is also slightly modified, and it retains its specific appearance in all the numerous localities in which it occurs.

Baron Schauth has lately figured a German example of it, which he refers to the preceding species. In the 'Versteinerungen,' pl. 4. figs. 51, 52, Geinitz refers some examples to the *Terebratula superstes*, de Vern., which belong apparently to this species.

It occurs in the compact- and shell-limestone, sometimes very plentifully.

10. CAMAROPHORIA HUMBLETONENSIS, Howse. PL. IV. figs. 3, 4.

"Shell subtriangular or obovate; perforated valve with a broad

sinus in the middle, rounded towards the lateral margins; imperforated valve high in the middle, depressed towards the sides; the front margin of the sinus and sides produced horizontally a short distance from the cavity of the shell; surface with numerous plaits in the sinus, which are sometimes bifurcated, and a few on the sides granulated."

This species was first described under the above name in the 'Trans. Tyneside Nat. Field Club,' where also some other peculiarities are pointed out by which it may be known and distinguished from the preceding species. The testimony of von Buch in favour of this opinion is singular, for at the same time that he separates *Terebratula Schlotheimi* from the *T. lacunosa*, he expressly says that the latter is found in the magnesian limestone at Humbleton.

It occurs in the shell-limestone at Humbleton, sometimes in considerable abundance. I have never found it at Dalton, nor do I think that it occurs there. I have however taken one specimen from the magnesian conglomerate of Tynemouth. It is a very local species, and has not yet been found, I think, in any foreign locality.

11. *SPIRIGERA PECTINIFERA*, Sow.—The internal structure of this very interesting shell is not correctly represented in King's Monograph, so far as I am able to judge from specimens collected at Humbleton. In the enlarged figure, tab. 10. fig. 9, the platform, or expansion between the crura of the loop, is much too large, and in fig. 10 the coil is represented with small blunt pectinations round its outer margin. This serrated appearance is due to mineralization, for upon close examination the entire coil of some examples is found to be covered all over with fine crystals. In the greater number of specimens of the interior that I have seen, the coil appeared quite smooth. For the perfect understanding of this species it will be necessary to consult Mr. Davidson's excellent plates, Mon. Brit. Perm. Brach. pl. 1. figs. 50–56, pl. 2. figs. 1–5, in which all the peculiarities of this singular shell are carefully represented. I have not however, up to the present time, been able to detect the presence of spinous processes on the margin of the coil.

In England this species is almost as limited in its distribution as the last, occurring only in the shell-limestone at Humbleton, Tunstall and Hylton, and in the magnesian conglomerate at Tynemouth.

12. *MARTINIA CLANNYANA*, King.—This species does not appear to be covered with spines, as some have supposed, but the outer surface of the valves is studded all over with minute granulations.

It occurs rather plentifully at Ryhope-Field-House, and Mr. Kirkby has recently taken it at Tunstall in shell-limestone. There are some specimens in the Sunderland Museum much larger than any others I have seen; they are from the compact limestone of Pallion.

13. *SPIRIFERINA CRISTATA*, Schloth.—It is more sharply triangular than any other Permian species occurring in this district. It is also well characterized by the sharpness and depth of its numerous plaits and the great size of the perforations of the shell.

It is rather sparingly distributed, occurring mostly at Humbleton and Tunstall in shell-limestone.

14. *SPIRIFERINA MULTIPLICATA*, Sow.—It is very much rounded in its general outline, and the plaits are less numerous and more rounded than in the foregoing species. The shell-punctures are very much smaller, so as not to be visible to the naked eye or impressed on casts. The *T. Jonesiana*, King, is only a more rounded form of this shell occurring commonly at Dalton.

It occurs rather plentifully in the shell-limestone of several localities.

15. *SPIRIFER UNDULATUS*, Sow.—I regret that I cannot assent to the division of this fine characteristic shell into three species, as proposed by Mr. King in the 'Permian Monograph.' The specimens figured in this work, pl. 10, are all referable to the above, and in the text no character has been pointed out of specific or even varietal value.

It is not very abundant in any locality, but may be met with most frequently at Humbleton in the shell-limestone. It occurs also in the compact limestone and in the magnesian conglomerate at Tynemouth.

16. *TEREBRATULA ELONGATA*, Schloth.—I agree fully with Dr. Geinitz, who has referred all the forms, including *T. sufflata*, occurring in the magnesian limestone, back to this species; and I deeply regret that the author of the 'Permian Monograph' has again attempted to raise the *T. sufflata* to the rank of a species, for surely nothing can be so injurious to the true progress of science as the burdening of it with useless synonyms.

This species is very abundant in several localities in the shell-limestone, of which it is very characteristic. It occurs at Tynemouth, in the magnesian conglomerate.

[To be continued.]

V.—Notes on the genus *Quenstedtia**. By JOHN LYCETT, Esq.

THIS genus of Lamellibranchiate Conchifera, described in the Great Oolite Monograph of the Palæontographical Society, was founded upon two shells figured in Prof. Phillips's 'Geology of Yorkshire,' under the names of *Pullastra oblita* and *Psammobia lævigata*, the former of them being chosen as the type of the genus.

Of *Pullastra oblita*, I have succeeded in clearing and exposing the hinge of each of the valves in many instances, and am perfectly conversant with its characters, which will be found correctly described in the Monograph alluded to. The siphonal, pallial and muscular scars were ascertained in a cast from the Yorkshire Dogger, and upon the characters supplied by these satisfactory materials the genus was founded. Specimens with the test preserved, and which admit of the hinge characters being exposed, are obtained in the upper portion of the Inferior Oolite of the Cotteswolds; a single young example of the species only having been afforded by the Great Oolite of Minchinhampton. In the Great Oolite Monograph it was stated to be allied to *Psammobia*, but distinguished from it by the dental characters of the hinge, and by the absence of an elevated nymphal plate to sustain the ligament. The general resemblance which the aspect of this shell presents to the *Mactromya mactroides* of Agassiz had not been overlooked, but as the figures of *Mactromya mactroides*, in the 'Etudes critiques' of that author, consist for the most part only of casts, which afford no information respecting the hinge, it was considered inadvisable to allude to the probable identity, as it was certain that *Quenstedtia* possessed no affinity either with *Mactra* or with the family of the *Myadæ*, and the shells of Phillips had priority as species. This supposed identity of *Quenstedtia oblita* with the *Mactromya mactroides* of Agassiz, has recently been fully confirmed in the publication by M. Terquem of an elaborate work, with plates, entitled, 'Observations sur les Etudes critiques des Mollusques fossiles, comprenant la Monographie des Myaires de M. Agassiz.' In this work the author has figured and described the *Mactromya mactroides*; the figures representing the shell and cast of the interior under different aspects: upon the same plate (No. 5) are placed figures of the recent *Psammobia vespertina* for comparison; the conclusion drawn by the author from this comparison is that *Mactromya mactroides* is a *Psammobia*. It will be observed that in these figures, the author has altogether omitted one of the most essential points of comparison necessary to establish a

* Read to the Cotteswold Club, Sept. 16, 1856.

generic identity, the hinges not being exhibited; he has, however, given casts of the interiors of the valves in both the shells, including the siphonal, pallial and muscular scars, but these afford no information respecting the hinge. The author arranges *Mac-tromya mactroides* with *M. tenuis*, *M. brevis* and *M. litterata*, all of which group he believes to be *Psammobia*; he also states that the group has a small cardinal tooth in each valve, which he regards as an abnormal variation from the dentition of *Psammobia respertina*, which has two teeth in each valve. As the author does not state expressly that he has cleared and exposed the hinge in each valve of *Mac-tromya mactroides*, and as he is careful to record similar facts relating to other genera, I am led to infer that his knowledge of the hinge in the shell in question has been derived either from the partial exposure exhibited by the valves when in contact, or from other imperfect evidence. However this may be, it is certain that the hinge is altogether unlike that of *Psammobia*: to avoid the trouble of reference, I subjoin the hinge characters of the fossil shell:—

QUENSTEDTIA. Hinge in the left valve consisting of one obtuse, oblong and transverse tooth, slightly compressed from above, situated beneath the umbo and received into a corresponding oblong pit in the hinge-plate of the opposite valve.

There is therefore no tooth in the right valve and consequently no pit in the left valve. This kind of hinge, which so nearly resembles that of the fossil genus *Myoconcha*, is altogether distinct from that of *Psammobia*, with its two grooved, diverging hinge-teeth in each valve.

The ligament is received into a narrow, lengthened and deep area posterior to the umbones;—the shell is therefore destitute of the elevated nymphal plate of *Psammobia*.

The siphonal flexure, as may be observed in the figure given by M. Terquem, is less considerable than in *Psammobia*, and, unlike that genus, it is united posteriorly to the pallial line *only at its extremity*, so that with the pallial line it forms a narrow tongue, the upper and lower borders of which are limited by the gradual convergence of the two lines: in *Psammobia* the siphonal and pallial lines are united in a position nearly vertical beneath the umbo, and proceed posteriorly united into a single line. The aggregate of these characters, it must be admitted, fully justifies the separation of *Quenstedtia* from *Psammobia*; and it yet remains to be demonstrated that true *Psammobia* are found in any rocks older than the Tertiary system, none of the so-called Jurassic *Psammobia* having hitherto exhibited the characters of that genus free from ambiguity.

VI.—On the Uses of the Sand-canal in the Starfishes. By
THOMAS WILLIAMS, M.D., F.L.S., Physician to the Swansea
Infirmary.

To the Editors of the Annals of Natural History.

GENTLEMEN,

Swansea, Dec. 22, 1856.

I HAVE recently accidentally fallen upon a very simple experiment, which brings directly under the eye at least *one* of the functions of the "Sand-canal" of the Asteroideæ. Let a specimen of the familiar *Asterias rubens* in the fresh state be allowed to creep gradually from the bottom up the sides of a dish, and then pour into the dish *very slowly* fresh salt water; proceed until the *level of the water* accurately corresponds with the inferior (as the specimen is placed) edge of the "eye," or the madreporiform tubercle, which is the external outlet of the sand-canal. Now fix the attention upon the smooth calm surface of the water. In a moment or two a powerful current will be observed. It commences at the eye or madreporiform tubercle, and travels in enlarging waves towards the sides of the vessel. In a minute or two more the phenomenon occurs again, and again and again at rhythmic periods. Now fix the eye intently upon the surface of the water in the vicinity of the "tubercle," in order to discover whether, during the *intervals* between these rhythmic currents, a *contrary* movement of the water takes place, that is, whether an *ingoing* alternates with the outgoing current. Try the experiment under every possible variation of circumstances, and you will convince yourself that it *does not take place*. The function of the eye or madreporiform tubercle then is to *discharge* externally from time to time the contents of the ambulacral or water-vascular system of *Asterias*.

If analogy may guide the reason, the *outlet* of the sand-canal of *Asterias* should be viewed as the exact equivalent of the "*fissures*" in the neck of the Nemertine Annelids, which, as I have recently *proved* (Dr. Carpenter first *conjectured* the fact), open in a *peculiar manner* into the vascular system. I could not rest satisfied until I had *tried* the question, whether the water entered into or issued from these "*fissures*." I placed an individual of the species—*Polia* (*P. quadrioculata*)—in a flat glass-cell under the microscope, and watched with very fixed gaze the neighbourhood of the fissures. I ascertained with perfect certainty that from time to time an *emission* of fluid takes place at these points; but in no instance could I satisfy myself that any *inspiration* of fluid from without succeeded to the *expiration*. From these and other reasons I have ventured to deduce the following conclusions :—

1. That the sand-canal is intended from time to time to *discharge* externally the fluid contents of the ambulacral system of tubes.

2. That the ambulacral or water-vascular system of those Echinoderms in which it exists, is a modification of a *part* or the whole of the so-called blood-vascular system of the Annulose families in general.

3. That in both the former and in the latter instances the fluid contained in the vascular system is *derived by absorption* from the cavitory fluid.

In a paper lately laid before the Royal Society I have described an organ in the Annulose and Radiated classes, which I have ventured for the present to call the "Segmental organ," and which is to the "*cavitory fluid*" what the madreporiform tubercle in *Asterias*, and the cervical fissures in the Nemertidæ, are to the contents of the vascular system. *Both* are provisions for the *immediate* and *direct excretion* of the *entire body of the nutritive fluids*. These facts prove that as we descend the scale of animal life, the mechanism of the physiological act of "*secretion*" is simplified in the ratio in which the fluids and solids of the living body themselves are simplified!

I remain, Gentlemen, your obedient servant,
THOMAS WILLIAMS, M.D., F.L.S.

VII.—*Remarks on the Inferior Oolite and Lias in parts of Northamptonshire, compared with the same Formations in Gloucestershire.* By the Rev. P. B. BRODIE, M.A., F.G.S.

HAVING, at a late meeting* of the Cotteswold Naturalists' Club, given a *vivâ voce* account of the Inferior Oolite and Lias in a part of Northamptonshire; at the request of the Secretary, I have prepared a more detailed description for our 'Proceedings.' It is well known that certain beds in the Inferior Oolite in the neighbourhood of Northampton have been extensively worked for the ironstone which largely prevails in it thereabouts, though I believe it is not now so generally used for æconomical purposes as it was formerly. This was certainly the case with those quarries which I examined near Blisworth. They are not worked to any great depth, and occupy the higher ground in the district; the strata consist of sandy ferruginous oolitic stone containing a few imperfect casts of shells, though the greater part of the mass is unfossiliferous: the top beds are coarse, and contain impressions of shells; the lower ones are more compact, and are composed chiefly of ironstone. The Inferior Oolite

* Held at Cheltenham in August 1856.

here appears to be of no great thickness, and differs materially from that of the Cotteswolds. The hills which are occupied by it near Blisworth are comparatively low, and form a striking contrast to those in Gloucestershire partly composed of the same formation. The fossils I obtained were a large *Cardium*, a *Trigonia*, a *Pecten*, *Terebratula*, and a few Univalves. Fossils are much more abundant at Northampton, though only occurring there in the form of casts.

Upper Lias.—From the position of the Inferior Oolite, the Upper Lias was to be looked for at a low level at the base of these hills, and I accordingly found it in a brick-pit in the valley at Bugbrook between Weedon and Blisworth, below the level of the Railway at no great distance from the Kilsby tunnel. Beds of Lias clay and shale are used for brick-making with the usual Upper Lias fossils, among which *Ammonites serpentinus* and *Belemnites* were very prevalent. The clay is traversed by a thin, continuous layer of limestone, which, as I anticipated, turned out to be the 'fish bed,' identical lithologically with the same band in Gloucestershire, and full of innumerable fragments of fish (though I could discover none entire) and coprolites, with some specimens of *Inoceramus dubius* and traces of *Sepia*.

This 'fish bed' has been noticed by Mr. Morris in parts of Lincolnshire and Northamptonshire on the Great Northern Railway, and it is very probable that it will be detected in other places where the Upper Lias occurs *in situ*, since it is rarely wanting, in its course through Somersetshire and Gloucestershire, at the lower part of this deposit. In fact, this 'fish and insect bed' seems as persistent in the Upper Lias as the 'Insect limestone' is in the lower.

The section at Bugbrook is as follows in descending order:—

- | | ft. | in. |
|---|-----|-----|
| 1. Rubbly white limestone in detached bits, in dark blue shale, with numerous fragments of <i>Ammonites</i> | 4 | 0 |
| 2. Thin-bedded limestone ('fish bed'); white externally, inside has a green tinge with white specks; it has a laminated fracture, and splits readily when weathered; it does not occur in nodules, but in a regular thin band in the clay | 0 | 3 |
| 3. Thin, coarse, dark-coloured slaty stone, very rough, covered with spines, teeth and plates of Echinoderms, resting on the marlstone. | | |

The thickness of the Upper Lias visible at this spot did not exceed a few feet; it is succeeded by the Marlstone with the usual fossils. I could not determine the total thickness of the Upper Lias, as there was no section exposed, but there must be a considerable mass of clay between the Inferior Oolite and the small section at Bugbrook, though probably not half so thick as

the Upper Lias in Gloucestershire, which, according to Mr. Hull of the Geological Survey, amounts at least to 200 feet in many parts of the Cotswolds.

These strata, as well as those of the Inferior Oolite, are perfectly horizontal. When the Railway was in progress, the top beds of the Lower Lias just below the Marlstone were exposed at Kilsby, and were as usual very rich in fossils, similar for the most part to those found in the equivalent strata at Campden, and Hewlett's Hill near Cheltenham.

The summit of Edge Hill in Warwickshire is capped by the Marlstone, the Upper Lias having been denuded; but small boulders of the 'fish bed,' containing scales of fish and '*Inoceramus dubius*,' are of frequent occurrence in the vale below, showing that it formerly occupied its normal position above the Marlstone in that district.

At Alderton, in Gloucestershire, the following strata were exposed below the 'fish bed' in April 1856, which seemed to be richer in fossils than usual, and therefore I have noted them here, which will enable the reader to compare them with those at Bugbrook above mentioned.

Brown and dark shales with many *Ammonites*, *Inoceramus dubius*, *Rostellaria* (abundant), *Cidaris**, *Nucula*, *Avicula*, and *Aptychus*. These are succeeded by two or three blue marly bands divided by shale, which contain a univalve like a *Cerithium*, *Avicula*, *Nucula*, *Pholadomya*, *Pecten*, *Astarte*, and *Ammonites*. A light blue, slightly indurated marl reposes immediately upon the Marlstone. The total thickness of these clays and marls forming the base of the Upper Lias is about 80 feet.

VIII.—Contributions to the knowledge of the Anatomy of *Nautilus Pompilius*, L., especially with reference to the male animal.

By J. VAN DER HOEVEN, M.D., &c. &c., Professor of Zoology in the University of Leyden†.

[With two Plates.]

THE Cephalopod Mollusks belong to those animals in which the sexes are distinct. Long ago the anatomical investigations of Swammerdam, Monro, Cuvier and others made us acquainted

* A similar small species of *Cidaris* (*C. minuta*) occurs abundantly with spines attached in the Upper Lias shale at Gretton near Winchcomb, where a fine specimen of a *Lepidotus* was lately discovered in the 'fish bed,' and is now in the collection of my friend Dr. Wright.

† From the Transactions of the Dutch Royal Academy of Sciences, 1856. Translated by Wm. Clark, M.D., F.R.S., Professor of Anatomy in the University of Cambridge.

with the organization, and in particular with the organs of propagation of these animals. Less notice has been taken of the external sexual difference; but from the silence of writers it might be suspected that the difference in question must be on the whole not great or interesting, as indeed in some species we know with certainty that such is the case*. To this, however, besides the genus *Argonauta*, some species also of the genus *Octopus* form exceptions. In male individuals of the last-named animal one of the arms lies in a bladder, from which it is developed at the time of copulation, is detached from the body and is taken into the shell of the female, where some years ago it was several times met with, and first, under the name of *Hectocotylus*† and *Trichocéphalus acetabularis*‡, was regarded as a parasitic animal form, and afterwards as the male animal itself, before the true bearing of the matter, as we have given it in few words, was recognized§.

Ever since the animal that inhabits the shell so long known as *Nautilus Pompilius* was described by Owen||, the principal question remained here also for investigation—what is the amount of sexual difference in this species? The individual so admirably investigated by Owen was a female, as were also those which were described after him by Valenciennes and W. Vrolik¶. The question, how far the general structure as well as the external

* In *Loligo* the female appears to be more elongate, at least Verany states this to be the case in *Loligo vulgaris* and *Loligo sagittata*. (*Mollusques méditerranéens*. Gènes, 1851, 4to, pp. 99, 109.) In *Sepia officinalis*, on the other hand, the female is rounder, and the males differ in having a white stripe around the fins (*ibid.* p. 69). In *Sepioida dispar*, Krohn has observed that the female is distinguished by larger suckers (Verany, *ibid.* p. 65). Delle Chiaje states that the males remain smaller, and that, particularly in *Loligo sagittata*, the male is one-fourth shorter than the female. (*Memorie sulla Storia e Notomia degli Animali senza Vertebre del Regno di Napoli*. 1829, p. 97.)

† Cuvier in the *Annales des Sc. Nat.* xviii. 1829, pp. 147–156.

‡ Delle Chiaje, *Memorie sulla Storia*, &c., ii. 1825, p. 225.

§ See on this discovery Verany, *op. cit.* pp. 126–129, pl. 41; H. Müller, *Ueber das Männchen von Argonauta Argo und über die Hectocotylen*; *Zeitschrift für wissenschaft. Zoologie*, iv. 1853, s. 1–35. tab. 1; compare Verany and Vogt, *Ann. des Sc. Nat.* 3 série, xvii. 1852, *Zool.* pp. 147–188, pl. 6–9, and R. Leuckart, *Ueber die Hectocotylen von Octopus Cuvier*; *Zool. Untersuchungen*, 3tes Heft. (Of this arm there must thus be an annual reproduction, respecting which I do not know whether any actual observations have been obtained.)

|| *Memoir on the Pearly Nautilus*. London, 1832, 4to.

¶ Valenciennes, *Nouvelles recherches sur le Nautilé flambe*, *Archives du Muséum*, ii. 1841, p. 257–314; W. Vrolik, *Brief aan den Gouverneur-Generaal J. J. Rochussen, over het ontleedkundig zamenstel van den Nautilus Pompilius*, in the *Tijdschrift voor de wis- en natuurkundige Wetenschappen*, uitgegeven door de Eerste Klasse van het Koninklijk Nederlandsche Instituut, ii. 1849, bl. 307–324.

form varies in the two sexes, was the more interesting, since the *Nautilus* differs in so many respects from all other cephalopods which belong to the present history of the earth, and finds its nearest affinities alone in fossil species of its own genus and of the numerous families of the Ammonites, an extinct group belonging to periods long passed away. Some years ago I happened to become possessed of a male specimen of this animal species, which however was in such a mutilated condition as to render the investigation of the internal parts impossible. Such deviations as I observed in the external parts of this specimen might still, however, be the result of occasional malformation, likely perhaps to occur in an equal degree in a female individual. In the description therefore which I gave of this specimen in the 'Instituut van Wetenschappen, Letterkunde en schoone Kunsten*,' I chose to abstain from a decided opinion, and to leave it undetermined whether there was here an individual modification of form or really a normal sexual difference. I advanced the latter as a surmise, which however appeared to be highly probable when, amongst the still increasing number of specimens brought to Europe, the same or similar deviations of form had not been observed.

From the year 1827, when I investigated this specimen, my attention was constantly directed to this point, and I am now in a condition to determine the question with full certainty. In the spring of 1855 I received, through the courtesy of his Excellency the Governor-General of the Dutch Indies, certain specimens of *Nautilus*, amongst which were several males in various states of preservation; and although all of them were thus not well adapted for the investigation of the internal organs, they nevertheless presented all the external parts uninjured, and agreed in the most minute particulars with the specimen examined in 1847.

Consequently I am no longer satisfied with a surmise, but am able to assert with perfect certainty, that in the external parts in the two sexes of *Nautilus Pompilius* a remarkable and constant difference prevails. To state clearly in what this difference con-

* 1848, bl. 67-73, pl. 1. figs. 1-3. These observations were afterwards published in the Trans. of the Zool. Society, vol. iv. part i. London 1851, pp. 21-29, pl. 5-8, under the title of "Contributions to the knowledge of the Animal of *Nautilus Pompilius*."

With respect to a peculiarity there announced, that in the spaces which the follicular appendages of the anterior branchial artery enclose, I had found a stony concrement, I may remark, that the same thing occurred to me afterwards in another specimen. The ossicle, investigated by Dr. L. C. Levoir at my request, weighed 0.47 grain (dried 0.438); had a spec. gr. of 1.66; it contained some traces of albumen, but no uric acid; and 70.4 per cent. of inorganic matter, principally neutral phosphate of lime.

sists, I think it better not to refer to and complete my former observations, but, with better means at my command, to describe continuously what I have observed. Some points must still remain in obscurity, where the investigation is confined to specimens preserved in spirit. It is therefore to be wished that these and other peculiarities in the anatomy of the animals may sooner or later be investigated by careful anatomists located in our colonies. I consider myself fortunate in having brought to light some additional facts in the anatomy of the *Nautilus*, which has been rendered by such an excellent investigator as R. Owen an object of common interest to all zoologists.

I.—*External form of the male Nautilus Pompilius, L.*

In the male and female *Nautilus* the general disposition of the body is the same. It consists of two principal portions, an anterior firmer and more muscular, comprising the organs of motion and of the senses, and including the horny beak, and a thin membranous sac in which the viscera are contained. This sac at its anterior part passes into a firm dermal lobe named the mantle, and opens externally under the first portion by the funnel formed of two lobes which lie upon one another*.

In the anterior portion we distinguish in the first place the *hood*. This is the name given by Owen to a membranous disk which the aperture of the shell encloses; it is higher behind, and, gradually becoming thinner forward, has the form of a cap. It is about 1 decimeter in length, and at its broadest part in the male has a breadth of from $7\frac{1}{2}$ to 9 centimeters. At the back part the hood is excised in the middle; this excision, about 4 centimeters in depth, corresponds to the turn of the shell which projects into its aperture. A longitudinal furrow on the upper

* Sometimes the right lobe of the funnel, sometimes the left, lies upon the other. This opening of the funnel below is a remarkable peculiarity, since in the other Cephalopods (the dibranchiate) the funnel forms a closed canal. I had already drawn attention to the fact, that this disposition in the tetrabranchiate Cephalopods (*Nautilus*) may be regarded as a persistent embryonal structure, since, according to Kölliker's observations, the funnel in the dibranchiate Cephalopods is, in the beginning, formed of two lateral parts which are distinct. (*Entwicklungsgeschichte der Cephalopoden* von Dr. A. Kölliker. Zurich, 1843, 4to, s. 41.)

I will here repeat the remark, in passing, that the aperture, by which, according to Owen, the mantle is perforated for the passage of the funnel (*Memoir on the Nautilus*, p. 9), has no existence. The mantle has a uniform free margin, on which the extremity of the funnel rests. I state this, because the second edition of Owen's *Lectures on the Comp. Anat. of the Invertebrated Animals*, which appeared after my 'Contributions,' still retains, by some oversight, the passage, p. 579, of the former edition: "The margin of the mantle is perforated below for the passage of the muscular expiratory and excretory tube called the funnel" (1843, p. 316).

surface divides the hood into two lateral parts; the upper surface is moreover rippled with transverse furrows, which cross, especially forwards, other finer furrows that run longitudinally; it is covered by many small scattered tubercles of unequal size, of which the largest resemble the *papillæ vallatæ* of the human tongue. Under the anterior margin of the hood is seen on each side of the middle furrow, at the distance of about a centimeter, a transverse incisure or aperture, from which a dark-grey ringed tentacle can be protruded; these tentacles retreat within the hood to about $4\frac{1}{2}$ centimeters. At each side of the hood lies the thick external integument of the head, which is divided into 18 incisures*. These incisures or slips coalesce behind and form, as it were, a cup; the undermost incisures close in over the funnel and are here connected by a thick margin excised anteriorly. Four of these slips lie more outward and backward; the rest form, as it were, a *verticillus*; on the inner surface all these slips form with the hood a connected whole, which, as an external covering, surrounds circularly the membranous oral mass in which the jaws are situated. The first slip that succeeds to the hood on each side, closes immediately upon it and forms above and forwards a border, as it were, round the hood, of the same colour and surface as itself; the remaining slips lie on the side and downwards, and are not visible in the aperture of the shell, by which they are covered at the side; they are of a paler colour and present ripples indeed, but no tubercles or papillæ. In each of the slips a ringed tentacle is contained, of the same colour as the two tentacles of the hood. These tentacles project, sometimes more, sometimes less, from the apertures of the slips, in which respect great variety prevails in different specimens; they can, however, be retracted entirely within the slips. Owen has correctly remarked that the hood is formed by the coalescence of the two uppermost slips of this encircling membranous covering of the mouth.

In these parts there is no remarkable difference from those of the females which have been examined hitherto; at least the difference does not consist in the number of the tentaculiferous slips. But it seems, on the other hand, that a variety in this respect may occur which is independent of sex; for Owen counted 19 slips on each side without the hood, in the specimen which he investigated. Eighteen however appears to be here the normal number, which I observed both in male and female specimens, and which Valenciennes found in his specimen also. But it seems to me not improbable that a sexual difference does exist in the form of the hood, and that with the same mean

* In one specimen I found on the right side only 17.

length it is about 2 centimeters narrower in females. With this also is connected a difference in the form of the shell: in male specimens it is broader and rounder at the aperture, more compressed laterally in females. The margin of the aperture of the shell also is, as it seems to me, more decidedly sinuous in the male, in the female more even.

These differences are, however, of small moment in comparison with that which the investigation of the slips situated more internally, and called by Owen *processus labiales*, presents. If we divide in *Nautilus*, whatever be its sex, the thickness of the hood mesially and then turn the external slips away from each other on each side, we find that the smooth inner skin, which covers the inside of the entire sheath, formed by these slips and the hood, gives off a fold of skin to which membranous thickenings are attached. These are divided into slips, which form cases in which retractile tentacles, similar to the external but less in size, are enclosed. Let us consider this disposition in the first place in male individuals somewhat more closely. The dermal fold, of which we have spoken, is here attached downwards with a free margin to the inside of the external circle of tentacles; the margins of attachment of the left and right sides of the dermal fold are distant from each other about 15 millimeters. Upwards on this fold is seen a membranous thickening (*labial process*) of about 3 centimeters in length, which at its anterior margin splits into eight flat digitiform sheaths. Through each of these sheaths there passes a ringed tentacle. The two uppermost slips are short, placed low on the basal part of the laminaform thickening, and are bent backwards; the six remaining slips are placed higher and are longer*. On the outside of this same dermal fold, but still also arising from it, there lies downwards, on the right side, a small membranous lobe which splits into four tentaculiferous slips. On the left side, in the same position, but extending farther backwards and more clearly distinct from the dermal fold, is found a large and thick body which is formed by the union of four largely developed and modified tentacles. We name this body, to which we shall recur, the *spadix*. It is the most characteristic part of the male *Nautilus*.

Besides these lobes and the tentacles contained in them, no other organs are found within the ring of the large tentacle-slips. The fold, so often spoken of, passes from above inwards into the skin which covers circularly the membranous, large, round, muscular mass surrounding the beak, and which, around the apex of the jaws, terminates in many short and tortuous

* The breadth on the left side amounts to 1, on the right side to 2 centimeters.

filaments, just like a border of fringe. At the commissure of the large tentaculiferous slips are found on the inside many furrows which are parallel to its excised anterior margin; whilst at the side and further back there are small cavities, from which the part obtains a retiform aspect. A continuation of the skin, at about 1 centimeter behind the excised margin, mounts upwards as a thin investment, to cover the tongue-bone, so named by Owen, and the entire muscular apparatus of the jaws, and passes into the skin arising from the dorsal surface, or rather forms a whole with it. Downwards, however, this membrane forms still another duplicature, a blind longitudinal sac, which invests a composite organ. From the transverse fissure above the duplicature, this organ comes partly into view by its superior margin. It is about 14 mm. broad and 18 mm. long, convexly oval on its upper surface, flat on its inferior surface, and lies like a little cushion below and behind the tongue-bone, and next the under surface of the commencement of the œsophagus. On opening the fold of skin that encloses it, this organ is found to consist of two lateral parts, bean-shaped, and turned towards each other at the fore-part with a convex margin. These two margins are divided by seven or more incisures* of 2 to 3 mm. in depth, into flat quadrangular slips that become narrower inwards. If the two lateral parts be separated from each other by a longitudinal section, then in each of them about fourteen other very thin laminæ are seen running obliquely towards the inner margin and downwards. The most external of these laminæ lies next a sinuous, smooth part, which becomes broader downwards. On the outside of this part is a small cavity within the very thick outer wall, which is formed by transverse loose fibres.

Let us now compare this disposition with what occurs in female individuals of *Nautilus*. Here there are on each side two lobes, which are divided into digitiform slips (*labial processes*, Owen). The *uppermost pair* is broader, and usually or almost always bears twelve tentacles†. The fold of skin which unites these lobes at the under side with the most external large tentaculiferous slips is covered by a number of fine membranous leaflets, which are distinguished into two groups. The *undermost pair* lies *within* the circle of the uppermost, and immediately towards the membranous mass which surrounds the jaws; they consist of a styliform part, which passes into a broader hand-shaped part forwards, and mounts at the side towards the membranous oral mass. Here I found sixteen tentacles on the

* In the specimen investigated by me in 1847, there were ten or eleven of these tetragonal slips. Trans. of Zool. Soc. iv. 1. p. 27. pl. 8. fig. 9.

† Here Owen and W. Vrolik found twelve *tentacula*, with which my observations constantly agreed; Valenciennes found thirteen.

right side, fourteen on the left side*. Within these innermost tentaculiferous slips, under the membranous mass of the mouth, there lies a part formed of eighteen or seventeen folds, which Owen considered to be the olfactory organ, but which, in my opinion, ought to be regarded as a continuation of the circle of innermost tentacles, which are here present in a rudimentary state. This part rests upon the fine membranous leaflets of the commissure of the preceding slips.

Here then it is apparent that a sexual difference exists. This difference, as to its nature, must be investigated more closely. It may be supposed that in the male Nautilus, as in the female, two pairs of labial processes are present. The first pair then would seem in the male to be placed *above* and *internally*, and to carry eight tentacles, whilst in the female it is placed *above* and *externally*, and carries twelve tentacles; the second pair would seem to differ from the undermost *processus labiales* of the female in the small number of only four *tentacula*, and still more in lying on the *outside* of the uppermost slips.

It was thus that I conceived the difference at an earlier period†. Closer investigation, however, produced a different conception, which I think preferable. Both sets of slips then in the male individual are attached to the same dermal fold, although the undermost set lies on the outside of the fold. I think, therefore, that these two groups of tentacles in the male Nautilus correspond to one pair alone of the labial slips of the female Nautilus, and that they are developed at the expense of the other pair. The commissure at the under side shows, that the pair to which they correspond is that of the outermost labial slips of the female Nautilus. In this way of conceiving the matter, the number also of the tentacles in the two sexes corresponds (8+4 in the male, 12 in the female).

The sexual difference may now be stated more clearly. The external labial slips are separated into two divisions, of which the undermost lies downwards and carries four tentacles. On the left side, this group of four tentacles is developed to form the *spadix*. The undermost or innermost labial slips appear to be wanting in the male. As rudimentary *processus interni* or *inferiores*, those parts however may be perhaps regarded which compose the organ at the innermost commissure, situated under the tongue and the jaws. The projecting leaflets in that part corre-

* In one specimen I found fourteen on the right side, thirteen on the left. Owen gives to these slips, as well as to the external labial slips, twelve tentacles; Valenciennes gives thirteen to each side; W. Vrolik, fourteen. Thus it appears that individual variety exists here, but that a greater number than in the external labial slips is to be regarded as the rule.

† Trans. of Zool. Soc. iv. 1. pp. 26, 27.

spond then with a greater fineness to those laminæ, which, with Owen, in his description of the female Nautilus, bear the name of olfactory organ. The fine membranous parts, on the other hand, which are present in the female at the commissure of the external labial slips, are entirely wanting in the male, and are represented by the retiform tissue that covers on the inside the commissure of the outermost tentaculiferous slips.

Let us now revert to the *spadix* on the left side of the male Nautilus. This body is 6 or 7 centimeters long, $4\frac{1}{2}$ or 5 centimeters high, and at the base 3 centimeters broad. A transverse section (Pl. V. fig. 1) plainly shows that it consists of four *tentacula*, of which three in particular are distinguished by their remarkable circumference, and of which the sheaths have mutually coalesced*. The undermost tentacle has only a short membranous sheath at its base, and elsewhere lies free along the inferior margin at the outside of the chief body of the *spadix* formed by the three remaining tentacles. On the outside of the membranous sheath of the uppermost tentacle of the *spadix* lies, close to the anterior extremity, a flat disk of an elongated round form, of $2\frac{1}{2}$ centimeters in the smaller diameter and 3 centimeters long. This disk is perforated by many small round apertures which are surrounded by a slightly raised border; they are distant from each other about 1 mm., in some places nearer together. A longitudinal section of the thickness of the disk shows that it consists of many follicles, which are perpendicular to its surface, are distinguished by sacciform dilatations of the walls, and have their openings at the apertures just mentioned.

To revert to the second principal portion of the body (p. 61), we may add, that the two swellings which are present in the undermost part of this portion in the female, are absent in the male†. The glandular organ, composed of many laminæ, which is here attached to the inside of the mantle in the female Nautilus, is wanting in the male; consequently Owen's opinion is confirmed, which regards this organ as connected with the sexual apparatus, and ascribes to it the secretion of a covering for the eggs‡. Moreover, it seemed to me that the mantle in the male Nautilus is shorter and leaves the eyes almost uncovered, whilst in female

* These tentacles present to the naked eye a structure corresponding to that which in the ordinary tentacles is observed by means of the microscope. Comp. R. Owen, On the structure and homology of the cephalic tentacles in the Pearly Nautilus, *Annals and Mag. of Nat. Hist.* xi. 1843, p. 308.

† Owen, *Memoir*, p. 9. pl. 1 e, pl. 2 e; compare my figures, *Transact. of the Zool. Soc.* iv. 1. pl. 5 h, pl. 6. fig. 3 h h.

‡ "A glandular apparatus . . . which, if not peculiar to, is in all probability more strongly developed in the female than in the male *Nautilus Pompilius*," p. 9. See further the description of this part, *ibid.* p. 43.

specimens the margin of the mantle extends over the middle of the anterior surface of the pedunculated eye-ball.

II.—*Male organs of propagation of the Nautilus.*

If the mantle be reflected or removed and the *Nautilus* be examined on the inferior surface, then it is found that the animal has a space or cavity which is distinct from the visceral cavity and contains the four gills. The position of the parts which are visible in this gill-sac agrees on the whole in the male *Nautilus* with that of the corresponding parts in the female. The penis however does not lie, at least not exactly, on our left hand, as does the aperture of the oviduct or the *vulva* in the female*, but almost exactly in the mid-line, between the *anus* and the funnel. This penis is of an obtusely conical form; on the dorsal surface, almost as far as its extremity, it is congruous with the skin, which is distended between two large muscular columns (the large shell-muscles), and by which the intestinal cavity is separated from the gill-sac. On our left hand, that is on the right side of the animal, is seen, between the *anus* and the first gill, at the base of the penis, a convex swelling, which is caused by a bladder lying under it.

Let us regard, however, before further consideration of the external parts, the internal organs of propagation. These consist principally of two glands, both of remarkable size (Pl. V. fig. 2). If we open on the dorsal surface the sac containing the viscera, then we find at the posterior end of this sac, on the left of the muscular stomach, the larger of these two glands, which however is in great measure concealed by the lobes of the liver, and on the right side also, in some degree, by the stomach. This gland, which, from the analogy of the other Cephalopods, must be regarded as the *testis*†, is included in a thin white membrane, as also the rest of the viscera are separately included in a similar investment. This gland has a length of about 7 centimeters, and at its broadest part a breadth of 4 centimeters; it surpasses all the rest of the viscera, the large liver alone excepted, in bulk, and with its anterior margin extends as far as the heart, thus occupying nearly the entire length of the visceral sac. It has a flat, oval form and is bounded on the left or outer side by a

* That is, on the right side of the animal, which in this position turns its back from us. See my fig., *Trans. of the Zool. Soc. L.c.* pl. 7. fig. 4.

† In the same situation in which the testis lies in the male *Nautilus*, the ovarium of the female is placed. Owen, indeed, says that the muscular stomach at the bottom of the visceral sac lies on the left, and the ovarium on the right (*Memoir*, p. 26, § 4); but this refers to the position in which the animal is figured by him (pl. 5), namely lying on its back and seen from the ventral surface.

margin convexly prominent, especially at the upper part. If the thin but strong integument of this part be removed, then the testis presents a brownish-yellow colour, and is seen to be divided into an upper and a lower half, and by transverse furrows that run obliquely into some loosely connected lobes. It is composed of a quantity of *acini*, which, with their blind extremities on the surface, look like white spots. The proper composition of the tissue of these *acini* was not apparent; the microscope indicated nothing but a granular mass. On the inside of the *testis* white ducts are seen which meet in a tube (*vas efferens*) that runs at the right side. This tube leaves the tissue of the testis, runs for a short space within the tegumentary sac, and terminates on a flat conical prominence by a small oblique aperture. The margin of this papilla presents radiating folds, and is in close union with the covering of the testis, which is perforated by the aforesaid aperture.

Above, and on the right side of the testis is situated a second gland, of a flat form, longitudinally round and smaller than the first*. It consists in part of many small lobules attached to flattish transverse partitions, and formed of microscopic finger-shaped blind tubules whose walls consist of cylindrical or conical cells (*cylinder-epithelium*). In the anterior extremity of this second sexual gland a saccule placed transversely is included, and is surrounded below by its tissue (Pl. VI. fig. 2). Behind this saccule is seen a milk-white body, in which I afterwards recognized, from the observation of Dr. J. A. Bogaard, Professor of the Leyden University, who investigated the sexual organs of *Nautilus* with me, the convolution of a tube. I succeeded in following the course of this tube further, which was somewhat difficult, since it is in close connexion with the tissue of the gland, and for the most part is concealed in the innermost portion of it. At its anterior extremity this tube terminates between the two slips of a nipple at the right side of the above-named saccule, then follows a course to the left towards the posterior margin of the saccule, then makes marked convolutions directed downwards and upwards and lying close together, afterwards proceeds, close along the right margin of the gland, backwards, again penetrates more into its depth, and finally ends as a fine canal of about $\frac{1}{2}$ millim. in diameter. The aperture of this fine canal, scarcely visible to the naked eye, is situated on the left side of the gland, which there presents a longitudinal furrow opposite to the conical excrescence in which the *vas efferens* of

* It now appears that it was this second gland which, in the imperfect specimen described by me in 1847, I saw in front of the testis ("a round mass that fell from the visceral cavity." *Tijdschr. uitgeg. door de eerste klasse van het Kon. Nederl. Instituut*, i. bl. 72).

the *testis* opens. By this furrow the said conical extremity is received in the natural position of the parts, and at its bottom is a fissure which leads to a small cavity of the gland, which is covered by a membrane with slight longitudinal folds, but in other respects smooth. At the upper part in this space the fine extremity of the convoluted canal opens. This canal is thus the *deferent vessel* (*vas deferens*), and the second gland is therefore to be regarded in part as an investiture of this deferent vessel. But this vessel is also the efferent duct of the secretion effected by the glandular tissue through which it runs, and is doubtless also itself moreover the seat of a secretion, since its walls present the same cylinder-epithelium as the *acini* of the surrounding gland. These walls are very thick, especially in the upper part, so that the inner space bears no proportion to the external circumference. This, on an average, has a diameter of two millimeters: anteriorly the tube becomes wider, but not uniformly; the two principal dilatations which it presents are fully three millimeters in diameter.

The sacculæ, of which we spoke above, forms a *diverticulum* terminating cæcally on the left side. Its inner surface has on the right side many projecting transverse folds, and presents here a second small aperture, situated immediately above the termination of the *vas deferens*; around this aperture the said folds form some circles. It is the inferior extremity of a tube 4 or 5 millimeters in length, with a circumference of about 8 millimeters. This tube has very thick walls, and presents longitudinal folds on its inner surface. It leads to the *spermophoresac**, a cylindrical bladder with very firm walls, so that when quite empty it does not collapse. The internal cavity of the bladder has numerous projecting folds that run longitudinally, and is divided by a partition running obliquely and having a free anterior margin into two cavities which communicate at the upper part. This bladder passes immediately into the canal of the *penis* (the *urethra seminalis*), which also presents strongly projecting longitudinal folds. The thick walls of this canal, which form the *penis*, consist of a very firm tissue; on the cut surface some round apertures are visible, which appear to be the sections of blood-vessels. At the extremity of the *penis* the termination of the *urethra seminalis* is seen as a transverse aperture surrounded by a thick margin, which is divided by incisures into some tubercles; on the surface that faces downwards, in particular, two such tubercles may be obviously distinguished.

In a specimen investigated by me, which had died during the

* The French writers on the anatomy of the Cephalopods name this part *poche Needhamienne*, after Needham, who is usually regarded as the discoverer of the spermophores.

period of sexual orgasm, I found the spermophore-sac, forcibly distended by its contents, to occupy the entire space between the anus and the base of the penis near the right anterior gill, whilst a spermophore filled the penis and came partially into view at its aperture (Pl. VI. fig. 1).

The parts found by me in *Nautilus* present on the whole the same type which we remark in the male sexual organs of the dibranchiate Cephalopods. The canal which I have indicated as *vas deferens* corresponds at its uppermost wider part, furnished with thick walls, with the part that Cuvier designates as *vesicula seminalis* in *Octopus*. The saccule in which this canal terminates may be compared with the part which this illustrious anatomist and others after him have regarded as a *prostata*, although with greater justice it may be taken for a *vesicula seminalis*. The glandular tissue which surrounds and covers the *vas deferens* seems to be wanting in the rest of the Cephalopods. In the smallness of the spermophore-sac, and in some other particulars, *Octopus* approaches nearer to *Nautilus* than do *Sepia* and *Loligo*; in the spermophores also, a closer affinity of *Nautilus* with *Octopus* may be remarked than with the ten-armed Cephalopods.

In the upper end of the efferent tube (that part which corresponds to the *vesicula spermatica* of authors), I found spermophores still imperfect and very soft; they were more developed in the small saccule in which the tube terminates; but a greater firmness and a definite convolution in spiral turns are seen first in the sac in which they are collected under the penis.

From this Needhamian sac, which beyond doubt is contractile, the spermophores are brought into the canal of the penis and from thence into the gill-sac. From thence they arrive, whether through the funnel or along the free margin of the mantle, at the different parts above, which as tentaculiferous slips surround the muscular bulb of the mouth.

That the spermophores tarry there for a time, before they leave the aperture of the shell to reach the shell of the female *Nautilus*, appears to me most likely. In three specimens I have found them there, and in all at the same part. This was on the dorsal surface, under the hood, and between the two first and smaller tentacles of the two *processus labiales*, those of the left side surrounding them like two fingers, whilst a cavity was, as it were, impressed for them at the base of the right tentaculiferous lobe by a bladder which enclosed the spermophore. *For here the spermophores do not lie uncovered; on the contrary, they are enclosed in a round, brown vesicle, which is about 18 millimeters long and 15 mm. broad, and of which the walls consist of three or four structureless membranes lying upon one another.*

I consider this covering of the spermophore as one of the most remarkable peculiarities which the investigation of the male *Nautilus* has revealed to me. The enclosing of the spermophores in the bladder must of necessity have occurred after they had passed through the penis. Even if I had not actually met with spermophores in the canal of the penis, as stated above (p. 70), which were not yet included in such a bladder, still the considerable size of the bladder would have precluded the possibility of a passage through that canal. The membranes of this bladder are thus secreted on the outside of the visceral cavity. Where and by what organs is the secretion effected? To this question I can only answer by conjecture. In the branchial sac nothing is seen that can perform the secretion. But on the other principal portion of the body are two organs which may be noticed here. In the first place, it may be supposed that the numerous folds of the organ situated behind the lower jaw below the œsophagus (p. 64) serve for secreting. In the second place, the round glandular disk deserves consideration, which is situated on the outer surface of the *spadix*. Whilst it is uncertain whether the first-named organ discharges a secreting office, there can be no doubt respecting such a function in the second; but it does not follow from this that the secretion which occurs in the said disk is exactly for the formation of the bladder which encloses the spermophore. Had I been fortunate enough to encounter in any specimen spermophores on the road from the branchial sac to the dorsal surface of the animal, then this matter might have been susceptible of a more accurate determination.

I am not in a condition to show how the bladder with spermophores is expelled from the shell of the male at a later period. A real copulation cannot take place: not only is the penis situated too deeply in the mantle for this, and too short, but moreover the enveloping of the spermophores shows that the expulsion of the sperma by the penis has preceded by some time the impregnation. I think I cannot be wrong in regarding the enclosing of the spermophores as a means of preserving the sperma for a time from the effect of sea-water until it has arrived at the place of its destination, the branchial sac of the female *Nautilus*.

We will, in conclusion, treat of the structure of the spermophores* or spermophores, as far as they can be investigated in specimens which have been long kept in spirit. It is well known that the sperma of Cephalopods is enclosed in singular bodies of very large size, which Swammerdam first described in *Sepia officinalis* as "witte en teere pennekeus, die zich in water bewegen en

* Duvernoy changed this name into spermaphores: by a slight modification, after the remark of a celebrated Hellenist, we prefer to write spermophores.

openbarsten"—white and delicate tubes which moved in water and burst open*, and which Needham investigated more closely in *Loligo*, whence they afterwards obtained the name of *corpora Needhamiana*. I always found in the bladder under the hood, described above, a single spermophore alone, and have no reason to conclude that it may contain two of them. This spermophore is of an extraordinary length, and lies in the bladder rolled up in many convolutions, just as the spermophores are already convoluted in the *vesicula seminalis*. I succeeded in unrolling one of them, but not without some pieces breaking off, and thus I can estimate the length at full 27 centimeters. Dr. Bogaard estimates the length of another spermophore, measured by him, at 34 centimeters. This remarkable length is not altogether without example in other Cephalopods: Milne-Edwards found the spermophores in *Octopus vulgaris* 8 centimeters long†, and R. Leuckart found in *Octopus Carene* the spermophore 3 feet long (Zoologische Untersuchungen, Drittes Heft, Giessen 1854, 4to, s. 98. not. 2). The spermophore of the Nautilus is a round tube, not everywhere of the same thickness; it is on an average 1 mm., and becomes fine at the two extremities. The smaller end presents a small bending back at an acute angle; this thin recurved part is about 3 mm. long. The point, finally, presented in one specimen a microscopic appendage in addition, which seemed to be split into two slips and left the before-named thin part at a right angle.

The colour of the spermophore, when it has left the penis, is brown-yellow. Within its cavity there lies a ribbon-shaped filament of about $\frac{1}{10}$ mm. in breadth, which is visible to the naked eye. This filament is flat and bent spirally in close circles, like the spiral thread in the air-tubes of insects. It consists in great part of spermatozooids which are attached by their capilliform extremities to the structureless thread situated in the middle‡. For other particulars I refer my readers to the careful investigations of Dr. Bogaard appended to this memoir, and put aside my own observations, which were not complete, rather than by a difference of conception give occasion, perhaps, in the reader, to uncertain and confused notions.

The structure of the *corpora Needhamiana* in the Cuttle-fish (*Sepia officinalis*) has been described exactly by C. G. Carus, who, however, has drawn up his description under the impression of a mistaken idea, that he had an animal existence

* Biblia Naturæ, p. 896.

† Ann. des Sc. Nat., 2 série, tom. xviii. 1842, Zool. p. 339. pl. 14. fig. 1.

‡ What I formerly described as flat, elongate-oval, microscopic bodies, hanging by the filament (Tijdschr. van de Eerste Kl. van het Koninkl. Instituut, i. bl. 72), I now regard as tissue detached from the spiral filament.

before him, a parasitic animal form*. Perhaps we may compare with those parts which he describes as fore-stomach and stomach of his *Needhamia expulsoria*, the parts at the thin extremity of the sperinophore of the *Nautilus*. After this description, we have from Peters and Milne-Edwards†, and from Duvernoy‡, indefatigable to the time of his death, excellent and extensive observations on the sperinophores in different Cephalopods. Considering that the specimens investigated by us were not recent, a comparison with these observations cannot be of much advantage. Certainly points of correspondence are not wanting, and as far as I can judge from the present state of our knowledge, the sperinophores of *Octopus* are those which have the closest analogy with the sperinophores of *Nautilus*. The last, however, differ by their extraordinary length from most of the Needhamian bodies that have been hitherto observed, and from all in being rolled up into close convolutions.

EXPLANATION OF PLATES V. AND VI.

PLATE V.

- Fig. 1.* Vertical section of the *spadix*. In the middle of each of the four tentacles, which make up this organ, is seen at *n* the section of a nerve that runs longitudinally. The darker tissue, running radially from the margin of the tentacle inwards, consists of longitudinal muscular bundles which have been divided transversely.
- Fig. 2.* The male organs of propagation of the *Nautilus*, from the dorsal surface, their peritoneal sac having been removed: *x, x, x, x*, the remains of this covering; *t*, the testis; *gl. acc.*, a second gland of the function of propagation, at the anterior part of which a thin membranous bladder (*prostata? vesicula seminalis?*) is enclosed; from it a canal mounts to the bladder, *v. sp. alt.*, which lies at the right side of the penis, *p*, and which corresponds to the Needhamian purse of other Cephalopods: from the aperture of the penis at *sp.*, part of a sperinophore is passing with the spiral thread which has become free from the bursting of the walls. At *p* is seen how the penis at this part is continuous with the wall which lies between the gill-sac and the visceral cavity. At † the aperture of the second gland is indicated by which the sperma from the testis is taken up, and above which, within the gland, the inferior extremity of the *vas deferens* is found.

PLATE VI.

- Fig. 1.* The penis and the testis of the specimen referred to in p. 70: *b*, the penis; *sp.*, sperinophore projecting from its aperture; *a*, the anus; *c*, the large muscle of the shell on the right side of the animal; *h*, the anterior, *h'*, the posterior gill of the same side; *g*, the mantle reflected.

* *Needhamia expulsoria Sepiæ officinalis*. Beschrieben und abgebildet von Dr. C. G. Carus, Act. Acad. Leop. Carol. vol. xix. P. i. 1839.

† By the last-named in Ann. des Sc. Nat. i. c. pp. 331-347.

‡ Mém. de l'Acad. des Sciences, xxiii. 1850.

Fig. 2. The tube that runs through the second sexual gland partly unravelled and freed from its covering: *a*, inferior aperture, *b*, superior aperture of this tube; the last is situated in the sac at the fore part of the accessory or second genital gland. In this sac above is seen at *b* the superior aperture of the duct; here also is *c*, the inferior aperture of the canal, *d. sp.*, which leads to the spermophore-sac.

Fig. 3. Vesicle in which a spermophore lay enclosed; of this the convolutions are partially seen through the walls.

Fig. 4. A spermophore unravelled, but broken at one of its extremities, here the upper one. The extremity, *a*, is represented in the next figure.

Fig. 5. The extremity, *a*, of the last figure, magnified 12 diameters.

All the figures except 5 are of the size of nature.

BIBLIOGRAPHICAL NOTICES.

Shells and their Inhabitants. The Genera of Recent Mollusca; arranged according to their Organization. By HENRY and ARTHUR ADAMS. London, Van Voorst, 8vo.

HAPPY the naturalists who have Van Voorst for their publisher! They shall not want for good printing and first-rate illustrations, and their works shall stand on the same shelf with those of the foremost scientific men of the age.

Such was our first thought on turning over the luxurious and costly numbers of this latest book on Conchology. The work is not yet completed, but has so far advanced that we cannot delay noticing it any longer. The first Number was published on January 1st, 1853, and at the present time all the Univalves and higher Mollusca have been described, leaving only the Bivalves and Tunicaries to form the subjects of a future notice.

As a Manual of the genera of Recent Shells it surpasses all its precursors, both in elaborateness of detail and beauty of illustration. To every one who writes on shells it will be indispensable, and the only thing to be desired is, that it will be used with discretion, and not followed indiscriminately. The work challenges comparison by its promise to supply a want, and we shall best fulfil our task by stating in what respects its guidance is to be distrusted, and specifying some of the points which require emendation. The authors have still the opportunity of making corrections, and will doubtless be obliged to us for making these suggestions ere it is too late.

The critical examination of these first 800 pages has proved a rather serious business; chiefly on account of the strange nomenclature, and the multiplication and novel arrangement of the genera. All our old conchological notions have been at a discount, and we have had to apply ourselves as to the study of a new art, written in a new language.

The number of univalve genera described is about 680, and 437 subgenera. The number of species enumerated exceeds 13,000, being rather less than 20 to each genus, and averaging nearly 12 to each genus and subgenus.

The authors have exercised a wise discretion in employing so large a proportion of their names in a *subgeneric* sense. For although this extreme subdivision of natural groups may be useful in a few great collections, and convenient in special or elaborate monographs; yet, for ordinary purposes, a much smaller number of divisions is sufficient. The generic names in general use do not exceed 300 for the whole of the living Encephalous Mollusca; and we are quite sure that no conchologist, or brace of conchologists—not even the authors themselves—will ever learn the eleven hundred and odd names here propounded; especially since so many of them are constructed in a form which takes no hold of the memory, *e. g.* *Neda*, *Aspa*, *Thala*, *Ziba*, *Dinia*, *Surnia*, *Ponia*, *Elara*, *Elaira*, *Ideu*, *Alaba*, &c. &c. To the exoteric public this style is by no means attractive, nor is the taste of naturalists in general so far behind that of the rest of the world as to lead them to prefer Adanson as a model.

Of the 18 genera and 121 new subgenera proposed by the authors, there is not one which calls for special notice; they appear to be founded on empirical characters, such as we should have regarded as possessing at most a specific importance.

The list of species appended to each genus and subgenus is one of the principal features of the work. It will be extremely convenient to those who have large collections, and may some time form the basis of what is very much wanted—a Geographical Catalogue of Shells. Of the 13,300 species, probably less than half are in the British Museum; but a larger proportion is in the Cumingian collection, which the authors are understood to have chiefly used. High as this number is, the land snails might now be increased by 1000 names, and some marine genera (like *Cypræa*) are far from complete; but many of the lists are swelled by the introduction of synonyms, varieties, and fossils, and will require considerable revision.

The space occupied by the lists of species exceeds one-fourth part of the work; while nearly another quarter is occupied with headings of various kinds. Thus before reaching the “Woodcock Murex” we encounter the following inscriptions:—

Class, GASTEROPODA.

Subclass, PROSOBRANCHIATA.

Order, PECTINIBRANCHIATA.

Suborder, PROBOSCIDIFERA.

Family, MURICIDÆ.

Subfamily, MURICINÆ.

Genus, MUREX.

Subgenus, HAUSTELLUM.

Species, haustellum.

The objection to this, however, is not so much the space it occupies,

or its technical appearance; but this excessive subdivision annuls the main object of classification, which is the massing of facts under the fewest heads possible. We must not omit to commend the general correctness of the press, which shows the advantage of double authorship. A few typographical errors appear to have been intentionally copied; such as *Onchidium* for *Oncidium*, *Melibe* for *Melibæa*, *Cythara* for *Cithara*, *Stobilus* for *Strobilus*, and *Triphoris* for *Triforis*. At the bottom of p. 64 a sentence is left unfinished; it should continue thus—"side, at the junction between the head and abdomen, with a foot-like appendage. (*Gray.*)" We have also noticed one paragraph which has quite escaped revision (at p. 15), where six errors occur in a dozen lines*.

The most attractive part of the work, and that of which we can speak with the greatest satisfaction, is the series of illustrations by that excellent engraver and veteran conchologist James D. C. Sowerby. No less than 88 of these admirably-executed plates are devoted to the 680 genera before referred to; the *subgenera* are not figured. Besides the shell of each genus, the *operculum* is given wherever it is known, and representations of the living animals have been selected, especially from the great French works of MM. Quoy and Gaimard, D'Orbigny, and Eydoux and Souleyet. Many of the figures are marked "original," but these are not always the best, and it is to be hoped the author will take a little more pains with any he may do in future†. It must be observed that the *opercula* are all drawn upside down; and no scale is given, so that *Helix pulchella* looks bigger than *H. rufescens*, and nearly as large as *H. cornu-gigantea*.

It will be necessary to examine and consider at some length the *nomenclature* and *classification* employed by the authors, both on account of the importance of their book and the extent to which it differs from the older treatises, especially the 'British Mollusca' of Messrs. Forbes and Hanley, so lately issued from the same press, and which has deservedly taken the highest place as a work of reference and authority.

On comparing the generic names employed by Messrs. H. and A. Adams with the terminology in general use, we find half the principal names (of the *univalves*) changed, on the pretence of *priority*! We say *pretence*, because a very slight examination would have shown that scarcely any of these names were accompanied by descriptions, or otherwise entitled to the adoption of conchologists.

The authors have judiciously omitted *dates*, having doubtless found them a "delusion and a snare;" but the omission of *references*, in so large and pretentious a work, is, to say the least, unusual.

* *Thetis* for *Tethys*; *thecidicola* for *tethydicola*; *Bær* for *Baer*; *Lingritula* for *Linguatula*; *Pinnotheros* for *Pinnotheres*; and *Phosphuga* for *Phosphuga*. At p. 252, *Chilinia* "*Cepuelca*" and "*pulchra*" appear to be misprints for "*Tehuelcha*" and "*Puelcha*."

† Some of these figures are obviously taken from specimens in spirits; such as the *Argonauta Oweni*, pl. 2, in which the sail-shaped arm is turned inside out; *Tornatella solidula*, pl. 56. f. 2; and *Pfeifferia micans*, pl. 72. f. 11.

We have added dates, from Herrmannsen*, to the following list of names, showing how long they have been in use. And to the names employed by the authors we have appended a few others of older date, which, according to their own rule, ought to have been preferred.

Names in use.

Hyalca, Lam. 1799.
Cleodora, Peron, 1810.

Creseis, Rang, 1828.
Cuvieria, Rang, 1827.
Clio, Linn. 1767.
Melongena, Sch. 1817.
Pleurotoma, Lam. 1799.
Triton, Montf. 1810.
Ranella, Lam. 1812.
Ricinula, Lam. 1812.
Monoceros, Lam. 1809.
Concholepas, Lam. 1801.
Magilus, Montf. 1810.
Oliva, Brug. 1789.
Ancillaria, Lam. 1811.
Fulgur, Montf. 1810.
Cynodonta, Schum.
Turbinella, Lam. 1799.
Pyrgula, Lam. 1799.
Sigaretus, Lam.
Cassidaria, Lam. 1812.
Oniscia, Sby. 1825.
Scalaria, Lam. 1801.
Solarium, Lam. 1799.
Pterocera, Lam. 1799.

Rostellaria, Lam.
Ovulum, Brug. 1789.
Pirena, Lam. 1812.
Paludina, Lam.
Siliquaria, Brug. 1789.
Crepidula, Lam. 1799.
Hipponyx, Deffr. 1819.
Neritina, Lam. 1809.
Navicella, Lam.
Phasianella, Lam. 1804.
Rotella, Lam.

Names proposed by Messrs. Adams.

Cavolina, "Gioeni" (not of Bruguière, 1792).
Clio, "Browne" (not. of Linn., Müll., Fabr., Brug., Cuv., Lam., Desh., or any other conchologist of note).
Styliola, Lesueur (teste Blainville).
Triptera, Q. & G. 1824.†
Chione, Pallas, 1774.
Cassidulus, Humph. (not. Lam., Fér., or Latr.).
Turris, Humph. (*Cophinosalpinx*, Kl. 1753).
Tritonium, Link (not Lovén); *Buccinum*, Kl.
Bursa, Bolten (not Bonanni or Petiver).
Pentadactylus, Kl. 1753. (Also *Tribulus*, Kl.)
Acanthina, Fischer, 1817 (*Thais*, Bolten, 1798).
Conchopatella, Chemnitz!
Campylotus, Guett.‡ (*Tubulites*, Davila).
Dactylus, Kl. (*Cylindrus*, Breynius).
Ancilla, Lam. (olim).
Busycon, Bolten.
Vasum, Bolten.
Mazza, Klein.
Sycotypus, Browne, 1756 (*Ficus*, Kl. 1753).
Catinus, Ad. ("Catinus-lactis," Klein).
Galeodea, Link (not Martini or Bolten).
Morum, Bolten, 1798 (*Cassidea*, Brug. 1792).
Scala, Klein.
Architectonica, Bolten (*Nerita*, Kl. 1753).
Harpage, Kl. (Also *Heptadactylus*, *Radix-bryonia*, &c.)
Gladius, Kl.
Amphiperas, Gron. 1781 (*Porcellana*, Kl.).
Faunus, Montf. 1810. (Young shell.)
Vivipare, Lam. (olim) *Saccus*, Klein!
Tenagoda, Guett. (*Solen-anguinus*, Kl.).
Crypta, Humph.
Cochleolepas, Kl.
Neritella, Humph. (*Vitta*, Kl. 1753).
Catillus, Humph.
Eutropia, Humph.
Umboonium, Link.

* Index Generum Malacozoorum. 8vo. Cassell, 1846-52.

† This name was given to an imperfect, and misunderstood specimen. In the same plate, and in the same page, the authors figured and described the perfect *Cuvieria* under the name of *Cleodora obtusa*, showing they had no intention of founding a genus (in *Triptera*) equivalent to *Cuvieria*.

‡ We cannot find any such "genus" in Guettard's Memoirs, but according to Blainville it was merely a name given to a miscellaneous assemblage, including *Vermetus*, *Scalaria*, *Magilus*, &c.

Names in use.

Delphinula, Lam. 1803.
 Puncturella, Lowe, 1827.
 Parmophorus, Bl. 1817.
 Acmaea, Esch. 1833.
 Tornatella, Lam. 1812.
 Doridium, Merkel.
 Umbrella, Lam. 1812.
 Goniodoris, Forbes.

Antiopa, A. & H.
 Embletonia, A. & H.
 Firola, Brug. 1792.
 Auricula, Lam. 1799.

Names proposed by Messrs. Adams.

Angaria, Bolten (*Cricostoma*, Kl.).
 Cemorina, "Leach" (Sw. 1840).
 Scutus, Montf. 1810.
 Tectura, Aud. & M.-E. (not defined).
 Actæon, Montf. 1810 (*Solidula*, Fisch.).
 Aglaia, Renieri.
 "Operculatum læve," Mus. Tessin.
 Doriprismatica, D'Orb. ("voc. pravum," Herrm.).
 Janus, Verany.
 Claria, Lovén (not the same thing).
 Pterotrachea, Forsk.
 Ellobium, Bolten (*Auris-Midæ*, Kl.).

The names thus introduced by the authors are of three kinds:—some are taken from works published before the time of Linnæus; others were never characterized, and come under the denomination of "MS. names;" while a few were published under peculiar circumstances, so as to escape observation, and have become obsolete.

With respect to pre-Linnæan names it is unnecessary for us to advocate the practice adopted by all the best naturalists; we will only hint the extreme inconvenience of a nomenclature ever liable to change, and ever receding into the obscurity of olden literature. If the names of Klein are to be adopted, why not those of Langius, and Davila, and Breynius, Bonanni, and Petiver? And if some of Klein's names are used, why not all?—"Cornu-hammonis" for *Spirula*, "Dontostoma" for *Nerita*, "Auris" for *Halotis*, "Hamus" for *Tectaria*, and "Auricula" for *Limnæa*? If *Pentadactylus* and *Argo-Buccinum* are to be introduced, why not also *Cophinosalpinx* and *Auris-Midæ*, *Saccus* and *Radix-Bryonia*, *Garagoi* and *Solen-angwinus*? Have not these also "priority"? And why is "*Catinus-lactis*," Klein, to be changed to *Catinus*, since euphony and taste are not to be considered? The folly of using "*Dactylus*, Klein," for the olive-shells is conspicuous, because the *Dactylus*, or date-shell, of all the other old writers is that burrowing bivalve the *Lithodomus*.

The question of manuscript names is more difficult, owing to the wilfulness of authors. One says it is sufficient to write a new generic name on a tablet and shut it up in his cabinet,—it is to be dated from that act*. Another distinguished Professor, of an English University, holds that to inscribe the name on a *Museum* specimen is a sufficient act of publication, leaving the determination of the date to the memory of the Curator. Some consider the insertion of a new generic name in a catalogue, without a word of description, without even a specific name attached, is sufficient to give "priority." Others, more modestly, admit the desirableness of the addition of a known specific name, but do not consider any description necessary; any one that pleases may find out the characters of the new genus, and if it has none, it is but one more name added to the synonymy. There

* Introduction to D'Orbigny's 'Prodrome de Paléontologie.'

are other authors besides Rafinesque, who will be remembered chiefly by the spurious genera they have made.

The genera of Humphrey, quoted in the foregoing list, appeared in the "Museum Calonneanum," a Catalogue published anonymously in the year 1797, and containing names only, without definitions. The names attributed to Bolten are also supposed to be taken from a Catalogue, but who has ever seen it? We have found the name "Gevers" placed as the authority for Meuschen's names in the Mus. Geversianum, and "Berlin" for Link's names in the Berlin Museum. But who wrote the "Museum Boltenianum"? The authors have not thought these things worth inquiring into, and we quite agree with them so far.

The Linnæan code, of which Herrmannsen gives an excellent digest, and the Rules of the British Association require that names should be really published, and accompanied by a description sufficient to identify the object and justify the imposition of the new term.

The last case we have to consider is that of names which have been properly defined in the pages of rare and obscure publications, and have remained unknown till discovered by chance after many years. The great work of Pallas, destroyed by fire, and not reprinted for half a century; the MS. of De Blainville's 'Malacologie,' mislaid by Dr. Leach; and Leach's own manuscript, unprinted till its value had nearly departed,—are examples of the casualties which attend authorship. In Messrs. Adams's Genera, we find the authority of Link cited for some names older than those of Lamarck; and it appears by a note of Herrmannsen's that four parts of a little work were printed in 1806-8, and afterwards burnt by their distinguished author; all that we know of them is derived from a solitary copy, found accidentally by M. Mörch, at Lund in Scania. Now, however much we may regret these circumstances, it may well be doubted whether names in general use—names which have been employed in many countries and in many books, and have become familiar as household words—should be changed "in justice to the memory" of authors long since removed from these and all other vanities.

It must not be supposed that the venerable nomenclature employed by our authors has been obtained by a vast amount of research, entitling them to throw off the fetters of the Lamarckian or any other "school." If they have not followed any of the great conchologists, they have borrowed their terminology from a very unpretending source—the Sale-Catalogue of the Yoldi Collection, by a young and enthusiastic native of Copenhagen, Otto Mörch (*angl.* Murk)—where we find all these names, prudently inclosed in brackets, *after those* which would be intelligible to the shell-buying world.

We feel bound to say that we cannot believe these names will ever come into general use; the authors have thrown fresh impediments in the path of the student, and have lost the opportunity of making theirs the chief and standard work on conchological nomenclature.

The classification adopted by Messrs. Adams will be most readily seen by putting in a tabular form, and translating for the convenience

of our readers, the names of those genera only which are regarded as *types of families*, and omitting nearly all the subdivisional names.

Class I. CEPHALOPODA : Order *Octopoda* ; *Octopus*, *Philonexis*, *Argonauta*.

Order *Decapoda* ; *Cranchia*, *Loligopsis*, *Chiroteuthis*, *Onychoteuthis*, *Loligo*, *Sepia*, *Spirula*.

Order *Polypoda* ; *Nautilus*.

Class II. PTEROPODA : Order *Thecosomata* ; *Hyalea*, *Cuvieria*, *Cymbulia*, *Limacina*.

Order *Gymnosomata* ; *Clio*, *Pneumodermon*, *Cymodocea*.

Class III. GASTEROPODA : Order *Pectinibranchiata* (*A. Proboscifera*) ; *Murex*, *Pleurotoma*, *Triton*, *Buccinum*, *Oliva*, *Fasciolaria*, *Turbinella*, *Voluta*, *Mitra*, *Marginella*, *Dolium*, *Pyrula*, *Velutina*, *Lamellaria*, *Natica*, *Cassia*, *Scalaria*, *Terebra*, *Pyramidella*, *Eulima*, *Stylifer*, *Cerithiopsis*, *Solarium*.

(*B. Taxifera*.) *Conus*.

(*C. Rostrifera*.) *Strombus*, *Cypræa*, *Ovulum*, *Pedicularia*, *Cancelaria*, *Trichotropis*, *Aporrhais*, *Cerithium*, *Melania*, *Littorina*, *Planaxis*, *Jeffreysia*, *Rissoa*, *Paludina*, *Valvata*, *Ampullaria*, *Turritella*, *Cæcum*, *Vermetus*, *Phorus*, *Calyptrea*, *Pileopsis*, *Narica*.

Order *Scutibranchiata* ; *Nerita*, *Trochus*, *Haliotis*, *Fissurella*, *Dentalium*, *Acmæa*, *Gadinia*, *Patella*, *Chiton*.

Order *Tectibranchiata* ; *Tornatella*, *Aplustrum*, *Cylichna*, *Bulla*, *Philina*, *Icarus*, *Aplysia*, *Pleurobranchus*, *Runcina*, *Pleurophyllidia*, *Phyllidia*.

Order *Nudibranchiata* ; *Doris*, *Oncidoris*, *Triopa*, *Tritonia*, *Proctonotus*, *Æolis*, *Hermæa*, *Elysia*, *Limapontia*.

Subclass HETEROPODA ; *Ianthina*, *Macgillivrayia*, *Atlanta*, *Firola*, *Phyllirhoa*, *Pterosoma*.

Subclass PULMONIFERA : (*A. Inoperculata*;) *Glandina*, *Testacella*, *Helix*, *Limax*, *Stenopus*, *Arion*, *Janella*, *Vaginulus*, *Oncidium*, *Auricula*, *Limnæa*, *Amphibola*, *Siphonaria*.

(*B. Operculata*;) *Cyclophorus*, *Helicina*, *Truncatella*, *Assiminia*.

In the first class, CEPHALOPODA, we see with regret, that the philosophical arrangement and terminology proposed by Prof. Owen has been abandoned for a new and empirical scheme, burthened with such frivolous terms as "*Chondrophora*," and "*Sepiophora*," &c. The great tetra-branchiate order is termed "*Polypoda*," although that phrase was employed by Gistel for the whole of the Cuttlefishes, and is most appropriate to the Octopods—the *Polypi* of the ancients. It is not contended that the law of priority applies to names of higher than generic importance,—they are formed by rule ; and in the other classes the names of the *Orders* are founded on *branchial* characters.

The first, and most important division of the GASTEROPODA, presents a remarkable scene of confusion, as if the Families had been thrown out of a dice-box. *Pleurotoma* is at the commencement, *Conus* (in a separate suborder) at the end ; *Fasciolaria* is separate from *Fusus*, and *Dolium* from *Cassia*. The shells called "*Nassaria*" are certainly

Tritons, and have no business with the "*Nassidæ*." We do not quite see the difference between "*Sipho*" (*Islandicus*) and "*Euthria*" (*cornea*); our difficulty has always been to know which was the Linneæan species—but now they are distinct genera. *Fastigiella*, at most only a form of *Cerithium*, is placed with *Turbinella* (p. 155), and *Ringicula*, which is known to be related to *Tornatella*, is associated with *Dolum* (p. 197). The authors have rightly hesitated to remove *Philippia* from *Solarium*, although unaware of one reason for keeping them together, viz. that in both the *apex is inverted* and can only be seen by looking into the *umbilicus*; this character affords an additional ground for putting them near *Pyramidella*.

In the second great division of Univalves (*Rostrifera*) we find the *Cypræidæ* placed between *Strombus* and *Aporrhais*, instead of following *Marguella* and *Erato* in the previous order; although amongst the illustrations are figures of *Erato lævis* and *Cypræa europæa*, both copied from Forbes and Hanley, who represent and describe them as being essentially alike.

Planaxis, placed next to the *Littorinidæ*, appears to us more nearly related to *Cerithium*; its lingual dentition also, according to the observations of Mr. Charlton of Gloucester, agrees better with that type.

Fossarus (p. 319) is made to follow *Lacuna*, its natural ally; but *Narica* ("Vanikoro") is placed much further on, at the end of the "bonnet-limpets" (p. 374). We should like to know how to separate these shells; for the distinguishing characters are not given, and many of the species enumerated might with equal propriety be referred to either. The same is the case with *Cyclostrema* (p. 405), and *Adeorbis* (p. 407), which appear to be identical.

Amongst the genera of Pearly Univalves we have been quite bewildered. All the leading facts and general circumstances are frittered away and lost sight of in the mass of petty details—of merely *specific* importance—which are here exalted into most prominent notice. Thus we find a "subfamily," of one genus, with no other character than *operculum orate* (p. 389), while the next "subfamily" has the *operculum orbicular*.

Passing on to the key-hole limpets, we find fifty kinds of *Fissurella* (including the British species) referred to Gray's genus *Lucapina*, which was certainly not intended for such a rabble. And in describing *Macroschisma*, the authors have forgotten to refer to their usual *vade mecum*, and ventured the original and very unfortunate remark that the "aperture is *much nearer* the front margin than in the other genera of the family"! (p. 447). We thought *Chiton amiculatus* had been the *type* of *Cryptochiton*, but find it placed in a separate "subfamily."

In the Nudibranchiate Order, *Melibæa* and *Doto* are referred to different families, with "*Proctonotidæ*" between; and the whole treatment of the group is in contrast with the beautiful monograph of Alder and Hancock.

The Subclass **HETEROPODA** is a remarkable assemblage, including *Ianthina*, which has a dentition and some other characters in com-

mon with *Scalaria*; *Phyllirhoa*, organized like the lowest *Nudi-branchiata*; and the fabulous *Pterosoma*, in addition to the *Atlantida* and *Friolida*, which in some respects resemble the *Stromba*.

In the Subclass PULMONIFERA the principal novelty is the constitution of the family *Oleacnidae*, for which there are good grounds, if it be restricted to the shells usually known as *Glandina*. It may however be doubted whether *Bulinus decollatus* and a hundred others which the authors have included, really belong to the family; least of all should we admit the little *Zua lubrica*, figured as an illustration of the group, and called by mistake "*Oleacina tridens*" (pl. 71. f. 1). On the other hand, they have placed in the same subgenus with the tiny needle-shell (*Cionella acicula*) the great *Glandina Algira*, which has a lingual organ as large as that of the *Testacella*, armed with equally formidable teeth, arranged in V-shaped rows. In the list of species we observe the *Achatina cylichna* of Lowe, which is a fossil; while the *Achatina gracilis* of the same author figures in three places, as *Oleacina (Aecea) terebella*, again as *Glundina (Acicula) gracilis*, and, 200 pages further on, as *Acicula gracilis*.

In the family *Auriculidae* ("*Ellobiidae*," Adams) we searched for our twin British species *Conovulus denticulatus* and *bidentatus*, which when young are so alike, but found no such name as *Conovulus*, although we encountered some strange characters called *Pira*, *Tsfata*, *Signia*, and *Persa* (the name-maker must have been terribly hard up!); at length we discovered our old acquaintances, under the disguise of *Leuconia* and *Alexia*, in two distinct subfamilies.

Lastly, we must confess that the position of *Truncatella* and *Assimineae* with the Pulmoniferous land snails is utterly beyond our comprehension at the present instant.

In the Prospectus attached to the first number of this work, the authors have very truly stated that at the present day there is a very general wish shown by zoological students to learn something of "the habits, organization, and affinities of the animals which construct shells." We have always found that those who took a hearty interest in shells, were still more interested in shell-fish, and without going into anatomical researches, there was enough in the study of external or zoological characters to afford very high gratification. Every one knows, who has studied natural history, that this pleasure is personal, and independent of utilitarian considerations or the stimulus of ambitious competition.

The Zoological Illustrations, and abridged descriptions of the animals of the genera, are certainly the most valuable portion of the work, and reflect the greatest credit on the industry and skill of authors and artist. We have had opportunity of seeing the pains taken by Mr. Sowerby to make the best of his materials. The paragraphs relating to structure, physiology, and habits, are scarcely so satisfactory as might have been expected from the profession of one of the authors, and the promise in the prospectus. The signs of compilation are obvious at every step, and too often of unintelligent compilation. In the first chapter the metamorphosis of the Gasteropoda is described as applying to *all Mollusca* (p. 7). The tongue of the carnivorous Gasteropods is said to be "forked and fleshy,"

while in some others it is coiled spirally "in the stomach;" the *Tunicata*, we are told, have no tongue. Some of the technical terms are used in such a sense as to require a special glossary; thus (at p. 13) some opercula are said to be "annular and multiapical," while in other places (e. g. p. 345) concentric opercula are called "annular." In plain English "annular" means like a ring, i. e. with a hole in the middle, and "no operculum presents an annular form *." At p. 14 we are informed, "the *epidermis*, like that of other animals, is inorganic, and cast off occasionally by the animal," and the shell itself is called "epithelium." At p. 18 the *Ortopoda* are defined as having "foot none;" but to make up for it, at p. 16, they have "ears developed." This last announcement would have amazed us more, but for the recollection of the phrase "auricular crests" employed by D'Orbigny for the little processes on the sides of the head in some Calamaries, and which have as much to do with hearing as the "ears" of the sea-hare. Under the genus *Achatinella* it is stated that "the females are ovo-viviparous" (p. 136), and again under *Partula*, "the females produce their young alive" (p. 145); we will not ask what the males are.

The references to fossil shells are few, and would have been better omitted, as the authors appear to have had no experience in such matters. They are certainly wrong in referring *Marginella pellucida* to the extinct genus *Volvavia* (p. 194); and are evidently misinformed about *Discohelix* and *Serpularia*, or they would not have described recent shells under those names.

Not much is made of the geographical distribution of the genera; at first the notices are very few and loose, but are more frequent afterwards, as the subgenera of land shells were chiefly founded on geographical considerations. We do not know what was intended by "north coast of America" given as a locality of *Neacma*; but at p. 92, for "low latitudes" we should read "high." *Tornatellina* is said to be found in Madeira, but the only Madiran species is removed to another family.

Most writers, especially when their publications extend over several years, become more cautious as they proceed, and we hope soon to congratulate the authors on the completion of their work in a style improved by experience; we shall do so more heartily if they will use the opportunity afforded by their preface and appendix to acknowledge and correct such things as may yet be rectified.

Das Gebirg der Schnecken, zur Begründung einer natürlichen Classification, untersucht von Dr. F. H. Troschel, Professor an der Universität zu Bonn. Erste Lieferung, mit vier Kupfertafeln von HUGO TROSCHEL. Berlin, 1856, 4to.

Dr. Troschel says that he has devoted twenty years to the study of the teeth of Mollusca, and laboured to collect every material that could throw light on the subject. He considers that there are now two classes of students, conchologists and malacozoologists; the latter take the only imperishable, unchangeable organ of the molluscous animal

* Owen, Hunterian Lectures on the Invertebrata. p. 543.

as their study; and for their justification the author alludes to the importance attached to the teeth in the classification of the entire animal kingdom, considering the anatomy of the mouth in Mollusca quite as important as in any other class of animals. Whether there are also peculiarities in the mouth-apparatus of Bivalves and other mollusks which do not possess any fixed portions and which suck in their nourishment from the tidal currents, the author leaves for future consideration, but considers that by further inquiries much might be learnt on the subject. He is also of opinion that this study of the teeth of Mollusca is of the greatest importance to the malacozoologist, for, while it is almost impossible, even in spirits, to preserve the soft, perishable bodies of the snails, it is doubly welcome to him to possess a fixed, decided, and easily preserved organ, which is so exactly calculated to establish the relations of the genera.

Very much has been written on the subject, but the results of these researches are so scattered and so little known, that the author has decided in the present work to collect all that has been published, and, with the addition of his own observations, so to arrange and illustrate the rich store of materials that every future student may with ease compare his own observations with those of others, and thus distinguish new discoveries from those already established. For this present work he copies all such drawings as relate to the subject, carefully noting the author and the book from which he takes them.

It is probable, in consequence of the interest which the subject has of late created, that during the publication of the work, much may appear of which the author may not be able to take notice. In order as much as possible to avoid this difficulty, he earnestly begs all who are studying the teeth of Mollusca to inform him without delay of the results of their labours, which he will publish (always provided the drawings be true to nature) with the fullest acknowledgment of the authorship.

Finally he proposes, at the close of the work, to write a supplement, in which he will make mention of such new discoveries as may have appeared during its publication, or that he may have overlooked in former works, and will feel grateful to any one who will point out any such omissions.

The part now published is devoted to the teeth of the Heteropoda, the Pteropoda, and part of the Pulmonata Operculata of the Gasteropoda, and is illustrated with four very clearly engraved plates, each containing many subjects, which, besides showing copies of the various figures which have been hitherto published of the teeth of these animals, contain a number of drawings of teeth now figured for the first time. We must consider this as a very important work, and shall watch its progress with interest.

As one fact of interest, we may observe that some of the *Cyclostomidae* figured show a great affinity to the teeth of *Proserpina*, described and figured in a preceding Number of this Journal, and in this manner an analogy to the numerous hair-like teeth of the *Trochidae*; but in these land shells, instead of there being a very large

number of hair-like teeth, there is a single very large lateral tooth divided into numerous more or less slender hair-like pectinate lobes, somewhat similar to the teeth of the *Orulidæ*.

Prodromus Systematis Naturalis Regni Vegetabilis; Auctore ALPHONSO DE CANDOLLE. Vol. 14. pars prior. Parisiis, 1856, pp. 492.

It is pleasing to have to announce the publication of another volume of this invaluable work, and to be able to state that it fully supports the character borne by its predecessors. These later volumes, which treat of Monochlamydeous plants, are also the more acceptable from their containing descriptions of Natural Orders, which, from their position in the usual sequence of the orders, have not been elaborated in many extensive systematic works. Some authors have commenced with the Ranunculaceæ, others have started from the Algæ or Graminæ, and have not been enabled to extend their respective works so far as to arrive at them.

This volume contains the Polygonaceæ by Bentham and Meisner, Myristicæ by A. de Candolle, Protaceæ by Meisner, Penæacæ and Geissolomacæ by A. de Candolle. The last of these, if really a distinct order, is singular as including only one known species of plant. The names of the authors are a sufficient surety that the plants have been carefully studied and skilfully described and arranged. We have had occasion to examine some parts of the book with care, and must be allowed to express our admiration of them. We may especially refer to the suborder Polygonæ, including, with others, the genera *Rumex* and *Polygonum*. Both of these present exceeding difficulty from the large number of closely allied species included in them. They are genera to which Professor Meisner has long paid much attention, and he seems to have drawn the line skilfully between the excessive tendency to combination of some writers, and the extreme desire to found new species, of others.

It is expected that other volumes will soon follow that which is now before us; and we may be allowed to express a hope, that the early volumes of the 'Prodromus' will soon be considered with a view of their being re-written, in conformity with the more perfect state in which their successors have issued from the press.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

February 26, 1856.—Dr. Gray, F.R.S., in the Chair.

ON SOME ADDITIONAL SPECIES OF BIRDS RECEIVED IN
COLLECTIONS FROM BOGOTA.

BY PHILIP LUTLEY SCLATER, M.A., F.Z.S.

MM. Verreaux of Paris, knowing the interest I take in New Grenadian ornithology, have most kindly transmitted to me some

specimens of birds from a collection lately received from Bogota, which did not appear to them to be included in my list, published in this Society's 'Proceedings' for 1855. I have also myself noticed a few others, which I had not previously remarked in collections from that locality. From these sources I am enabled to lay before the Society a list of twenty-two species, which, added to those given in my former catalogue, raise the total number of birds now ascertained as belonging to this peculiar fauna to 157.

1. NYCTALF HARRISI, Cassin, Pr. Ac. Sc. Phil. (1849) iv. p. 157, et Journ. Ac. Sc. Phil. N. S. ii. p. 53, pl. 5. *Ciccaba gisella*, Bp. Consp. p. 11. *Gisella harrisi*, Bp. Compt. Rend. 1855, Oct. 22nd. 'Nyctalitus albipunctatus, Kaup,' Gray, Cat. of Gen. of B., App. p. 135.

Dr. Hartlaub writes me word that the Bremen Museum has a Bogota specimen of this peculiar Owl, and the example in the Norwich Museum named by Dr. Kaup *Nyctalitus albipunctatus* was received, I believe, from the same locality.

2. SYNALLAXIS ELEGANS, sp. nov.

S. pallide murino-brunnea, infra medialiter albescentior, ventre medio candido, crisso et lateribus dorso concoloribus pileo toto, nisi fronte, alis extus et cauda rufis: loris albescentibus.

Long. tota 6·4, alae 2·2, caudæ 3·7.

This *Synallaxis* is very like a common Brazilian species, *S. ruficapilla*, Vieill., which it resembles in having the head, wings and tail bright rufous. But in the present bird the rufous colour does not extend over the front, which is brown like the back, there are no yellowish supercilia, or at least the very faintest traces of them, and the under plumage is not cinereous, but brown like the upper, only paler, and medially passing into white, which colour is quite pure in the middle of the belly. The tail is longer, and the webs of the rectrices are not so broad as in the Brazilian bird.

This species, like other true *Synallaxes*, has only eight large rectrices and an outer pair abnormally small. Other birds, often placed in this genus, have twelve, which is the number given by Vieillot in his generic characters, but I consider this erroneous, and believe the former number to be the normal one.

The present bird seems not uncommon in Bogota collections, but has probably been hitherto confounded with its several allied species.

3. SYNALLAXIS MÆSTA, sp. nov.

S. olivascens-brunnea, subtus paulo dilutior: alis intus nigris, extus castaneis: cauda rufa: loris et gutture albidioribus: tectricibus subularibus pallide fulvis; rostro valido, nigro; mandibula inferiore basi albescente: pedibus pallidis.

Long. tota 5·2, alae 2·5, caudæ 2·5.

The single specimen which I possess of this bird was received from MM. Verreaux. It is of a nearly uniform olive-brown, rather lighter below, particularly on the throat and sides of the head. The chestnut margin of the quills grows narrower towards their apices, leaving the

dusky black apparent, but at their bases extends through both webs and shows itself underneath. The tail is pure rufous and very short, but I am not quite certain that it is of its normal length in my specimen, there being indications of a state of moult. The bill is rather stronger and more conical than in most species of the genus.

Out of the six *Synallaxes* described by M. de Lafresnaye (Rev. Zool. 1843, p. 290) as from this country, I have as yet only met with three, namely, *S. gularis*, *cinnamomeus* and *unirufus*, which I have been able to identify with certainty. I have, however, specimens of a Bogota bird of this genus which I think may possibly be his *S. fuliginosus*, and there are examples of the same species in the British Museum. If I am correct in my conjectures, I may remark, that the description he gives of this bird is hardly sufficiently accurate, and I can only refer my specimens doubtfully to his species with the following characters :

4. *SYNALLAXIS FULIGINOSA*, Lafr. R. Z. 1843, p. 290 ?

S. supra rufescenti-brunnea, alis extus paulo clarioribus, cauda adhuc clariore, pure brunnescenti-rufa, scapis plumarum nigris : rectricibus decem, angustissimis et tenuissimis : loris et superciliis indistincte albidis : infra obscure cinerea, mento summo et ventre albescentioribus : rostro nigro : basi mandibulae inferioris albicante ; pedibus validissimis clare brunneis.

Long. tota 6.5, alae 2.3, caudae 3.75.

The tail of this bird is of a clearer and more reddish-brown than the back, with the shafts of the feathers black. The outer pair of rectrices are abnormally small, measuring only one inch in length, the next pair about double that length. The webs of all are exceedingly narrow, in particular the outer ones, and grow finer towards the extremities.

This form of *Synallaxis* shows evident *rapprochement* towards *Sylviorthorhynchus*.

5. *ANABATES RUFICAUDATUS*, Lafr. et d'Orb. Syn. Av. in Mag. de Zool. 1838, p. 15.

I possess a Bogota skin, received from MM. Verreaux, which M. de Lafresnaye has kindly identified for me as being of this species.

The apical portion of the outer primaries in this bird is black, which colour gradually diminishes in extent in the succeeding feathers, and is reduced to a minimum in the secondaries, where it only forms a blotch at the ends. The first quill is nearly wholly black, and in those next succeeding the same colour advances far up the stems, being broadly margined outwardly with chestnut, and inwardly with paler cinnamomeous.

6. *ANABATES ERYTHROPTERUS*, sp. nov. ?

A. supra pallide brunnescenti-cinereus ; alis extus et cauda tota rufis, remigum exteriorum parte apicali nigra : loris oculorum ambitu et gula cum tectricibus subalaribus cinnamomeis : corpore cetero

subtus pallide cinnamomescenti-albido, lateribus olivaceo tinctis : rostro albido, culmine nigrescenti-plumbeo : pedibus pallidis.

Long. tota 6·2, alæ 3·6, caudæ 3·1.

The only *Anabates* I know of likely to resemble the present species is *A. guianensis* (Pl. Enl. 686, fig. 2). I have never seen that bird, but if it has been correctly described, there is no doubt that this species is distinct.

7. *XENOPS RUTILANS*, Temm. Pl. Col. 72, fig. 2.

A Bogota skin received from MM. Verreaux seems referable to this bird, though there is rather more black in the tail than in my Brazilian specimens.

8 *MARGARORNIS BRUNNESCENS*, sp. nov.

M. umbrino-brunnea, capitis dorsique superi pennis obsolete et angustissime nigro marginulatis : infra pallide ochraceo-albo guttulata, his guttulis nigro cinctis et deinde umbrino brunneo terminatis : loris et gutture medio ochraceo, nigrescente paululum variegatis : rostro superiore nigro, inferiore flavido, pedibus clare brunneis.

Long. tota 5·5, alæ 2·5, caudæ 2·5.

MM. Verreaux have transmitted to me a single specimen of this bird, which forms a second species of the genus *Margarornis*, instituted by Reichenbach for the *Anabates squamiger*, Latr. & d'Orb. M. de Lafresnaye has also coined the name *Anabasitta* for the same form, but I believe the first-mentioned term has a slight priority. The type of the genus is very common in collections from Bogota. The present bird may be distinguished from it at once by the want of the bright chestnut colouring on the back and tail. In form, however, there is not much difference. In *M. brunnescens* the beak is rather longer, and the first two primaries proportionately rather shorter. The elongation of the naked stems of the rectrices is carried to a greater extent in the present species than in the other. There are twelve tail-feathers, and they all terminate in a similar hair-like point. The plumage of the two species below shows much similarity, but in the "*brunnescens*" the tear-like spots are yellowish.

I may remark that Reichenbach has kept the Bogota and Bolivian *Margarornithes* apart, but M. de Lafresnaye, who knows both species, considers them identical. It is with Bogota specimens that I have been comparing the present bird.

ALECTRURINÆ ?

9. *OCTHOËCA FUMICOLOR*, sp. nov.

O. supra fumoso-brunnea, dorso imo rufescentiore : alis caudaque nigris : tectricibus alarum rufo bivittatis, et secundariis ultimis extus rufescente marginatis : superciliis latis et fronte ad nucham ochraceo-albis : subtus brunnescenti-murina, ventre medio albescentiore, gula quasi dorso concolore, sed pallidiore : rostro et pedibus nigris.

Long. tota 6·0, alæ 3·5, caudæ 3·0.

This bird appears to be naturally placed in Dr. Cabanis' genus *Oethoëra*, of which the type is *Oethoëra ænanthoides* (*Fluvicola ænanthoides*, d'Orb. Voy. pl. 38, fig. 2).

Other species belonging to this same group are *Oethoëra leucophrys* (*Fluv. leucophrys*, d'Orb. Voy. pl. 38, fig. 1), which the present bird most resembles in colouring; *Oethoëra rufipectoralis* (*ibidem*, pl. 37, fig. 2); *Oethoëra Lessoni*, mihi (*Tyrannulus rufipectus*, Less. Descr. des Mamm. et Ois. p. 296); *Oethoëra albidicoma* (*Setophaga albidicoma*, Lafr. R. Z. 1848, p. 8), and, perhaps, *Setophaga cinnamomeiventris*, Lafr. R. Z. 1845, p. 80. The three species figured by d'Orbigny are from Bolivia; the three latter, like the present, from Bogota. They all offer considerable similarity in colours, and present, so far as I am acquainted with them, the same structure. M. de Lafresnaye has indicated the existence and affinities of this group in his article in the 'Revue Zoologique,' 1848, p. 8. All d'Orbigny's species inhabit his third zone of elevation, that is, above 11,000 feet above the sea-level, and it is probable, therefore, that the New Grenadian *Oethoëra* are likewise from the higher regions of the Andes.

10. *EUSCARTHMUS AGILIS*, sp. nov.

E. supra nigro et pallido brunneo mixtus, pennis plerumque nigris brunneo marginalis: crista capitis totius medialiter nigra, lateraliter autem et subtus pallide brunnea: alis nigris, tectricibus rufescente terminatis, secundariis extus pullescentibus: cauda unicolore nigra rectricum mediarum apicibus et omnium marginibus exterioribus pullescentibus: subtus pallide fulvo-flavidus; capitis lateribus et gutture toto albis nigro variegatis; pectore longitudinaliter nigro flammulato: rostro nigro, mandibulæ inferioris basi alba: pedibus nigerrimis: tectricibus subalaribus pallide fulvis.

Long. tota 4·6, alæ 2·2, caudæ 2·4.

This bird much resembles *Euscarthmus parulus* and *E. albicristatus* in general appearance, and may, I think, be safely placed in the same genus, though the bill is slightly broader, and the tail is proportionately rather longer, and has the rectrices more graduated.

The only example I have seen of it was transmitted to me by MM. Verreaux.

In the markings of the lower part of the body it is not unlike *E. parulus*, but the ground-colour is more yellowish, and the strise less distinct on the throat and more marked on the breast. Above, these two species are easily distinguishable. The present has the back brown, mixed with black blotches, and not uniform cinereous-olive, and the crest is shorter and differently formed, the whole of the head-feathers being moderately lengthened, not a few of the centre feathers only, as in the older species.

PIPRINÆ.

11. *PIPRA CORACINA*, sp. nov.

Pipra leucocilla, Selater, P. Z. S. 1855, p. 152.

Pipra coracina, J. et E. Verreaux, MS.

♂ *coracino-nigra: pileo nuchaque albis: rostro nigrescenti-plumbeo:*

pedibus nigris. ♂ junr. viridescenti-cinereus, pene unicolor, alis caudaque intus nigris.

Long. tota 3·5, alæ 2·8, caudæ 1·2.

MM. Verreaux have transmitted to me an adult and young male, and their MS. description of this species of Manakin, which they consider distinct from the well-known *Pipra leucocilla*, and I am inclined to think they are right. The black colour is generally more intense in the present bird, the white extends further back down the head, the wings are longer, and the bill rather shorter. They remark that the Peruvian bird (which I have not yet seen) appears to be the same as this species.

FORMICARIINÆ.

12. CONOPOPHAGA CUCULLATA, sp. nov.

C. supra brunnescenti-olivacea, alis caudaque nigricantibus brunnescente marginatis: capite toto et cervice postica cum gula et tectricum alarum marginibus clare rufo-castaneis: plaga pectorali alba: abdomine dilute cinereo, ventre medio et hypochondriis roseo aut rufescente tinctis tectricibus subalaribus flavicanti-brunneis: rostro flavo: pedibus pallidis.

Long. tota 4·0, alæ 2·7, caudæ 1·1.

The single specimen sent to me by MM. Verreaux is the only example I have yet seen of this *Conopophaga*. It is not likely to be confounded with any other species of the genus that I am acquainted with, its bright chestnut head and throat and white pectoral patch rendering it eminently distinguishable.

ICTERINÆ.

13. STURNELLA LUDOVICIANA (Linn.).

A single bird transmitted by MM. Verreaux seems to belong to this species. The yellow belly is rather brighter than in U.S. examples, but at present I can discover no essential difference. It is singular, if this is the North-American species, that the Mexican bird (*Sturnella hippocrepis*, Wagl.) is usually considered distinct.

EMBERIZINÆ.

14. EMBERIZOIDES MACRURUS (Gm.). *Fringilla macroura*, Gm. S. N. i. 918. *Tardivola macroura*, Cab. M. II. p. 135 (note).

A Bogota specimen of this bird which I have lately acquired agrees with the true *E. macrurus* from Cayenne, and seems to be quite distinct from the Brazilian *E. marginalis* (Temminck), with which it is generally made synonymous.

TANAGRINÆ.

15. CHLOROSPINGUS XANTHOPHRYX, sp. nov.

C. brunnescenti-olivaceus: loris nigricantibus: superciliis curtis a fronte ad oculum summum et corpore mediali subtus flavis: rostro nigro: pedibus pallide brunneis.

Long. tota 4·7, alæ 2·5, caudæ 2·4.

Obs. Similis *C. superciliari*, sed minor, et superciliis brevioribus et flavis, capite non cinerascante, lateribusque olivascentibus dignoscendus.

I possess a single example of this bird, and have seen others.

16. *CHLOROSPINGUS LICHTENSTEINI*, sp. nov. *Nemosia verticalis*, Licht. in Mus. Berol. (partim).

C. supra cinereus, alis caudaque nigricantibus; pileo atro: vitta mediali verticis ochraceo-albida: subtus albidus lateribus cinerascantibus.

Obs. Similis *C. verticali*, sed major, gula ventre concolore, nec nigra.

There is a single example of this bird in the Berlin Museum, received from M. Boissoneau of Paris along with specimens of *C. verticalis*, and not distinguished from that species.

COLUMBÆ.

17. *CHLORÆNAS BICOLOR* (Vieill.). *Col. bicolor*, Vieill. N. D. d'H. N. xxvi. 345. *C. vinacea*, Temm. Fig. t. 41. Mus. Brit.

18. *ZENAI DA RUFICAUDA*, G. R. Gray, MS. Bp. Coup d'œil sur l'ordre des Pigeons, p. 42. Mus. Brit. et Paris.

19. *ZENAI DA PENTHERIA*, Bp. Coup d'œil, p. 42, et Consp. ii. p. 84. Mus. Brit.

20. *CHAMÆPELIA AMAZILIA*, Bp. Coup d'œil, p. 38, et Consp. ii. p. 84. Mus. Brit.

GALLINÆ.

21. *CHAMÆPETES GOUDOTI* (Less.). *Ortallida Goudoti*, Less. Man. d'Orn. ii. 217; et Tr. d'Orn. i. p. 481. *Chamæpetes Goudoti*, Wagler, Isis, 1832, p. 1227.

GRALLÆ.

22. *GALLINAGO NOBILIS*, sp. nov.

G. supra nigro-cinereo et brunneo (sicut in plerisque hujus generis speciebus) variegata: pileo summo nigro, vitta mediali irregulariter cinnamomeo-brunnea: capitis lateribus et cervico postica pallide cinnamomeo-brunneis, minute nigro punctatis; his punctis intra rictum et oculum lineam formantibus: scapularibus nigris cinnamomeo vittatis, plaga subterminali nigra præditis et extus iterum late ochraceo-albo marginatis: remigibus omnibus pure et pallide nigricanti-cinereis, secundariorum et alulæ spurie apicibus extus pullescentibus; rectricibus albedo et cinereo variegatis: subtus, gutture albicante, pectore toto cinnamomescenti-brunneo, nigricante flammulato; ventre toto albo, hypochondriis et rectricibus subalaribus albo nigroque regulariter transvittatis; rectricibus subcaudalibus albis cinnamomeo tinctis et nigro obsolete transfasciatis: caudæ rectricibus sedecem; harum octo mediis nigris clavo rufo late terminatis, hoc colore rufo iterum sub margine anguste nigro vittato; una utrinque proxima præcedentibus assimili,

sed colore nigro ochracecente maculato et terminatione rufa non æque lata; tribus autem utrinque extimis ochracecentibus nigro irregulariter transvittatis: rostro longissimo, brunnescente, apice nigra, basi pullidiore: pedibus nigro-fuscis.

Long. tota 11·0, alæ 5·7, caudæ 2·2, rostri à rictu 3·7, tarsi 1·5.

There is an example of this fine large species of Saipe in the British Museum, from Mr. S. Stevens's Bogota collection, and MM. Verreaux have also lately transmitted a single specimen to me. It is of about the same size as Temminck's *Scolopax gigantea*, but that species appears to have the wings banded. In the present bird the quills are uniform slaty black. The spurious wings and secondaries are edged with buffy white, and all the wing-coverts are terminated with the same colour, forming irregular barrings.

23. *RALLUS SEMIPLUMBEUS*, sp. nov. ?

R. supra brunnescenti-olivaceus, nigro flammulatus, alis caudaque nigricanti-brunneis; alarum tectricibus rufis: loris nigris: capitulis lateribus et corpore toto subtus plumbeis; mento et gulari stria albis: tectricibus subcaudalibus albis nigro mixtis: rostri culmine et apice nigris; mandibula autem inferiore ruberrima: pedibus pallide brunneis.

Long. tota 8·5, alæ 4·4, caudæ 1·8, rostri 1·7.

This is a true *Rallus*—near *R. virginianus* of the U.S.—of which MM. Verreaux have sent me a single specimen. I have tried in vain to make it agree with any recognized species, and have therefore provided it with a (temporary ?) name.

March 11, 1856.—Dr. Gray, F.R.S., in the Chair.

NOTE ON *PSALTRIA FLAVICEPS*, A THIRD AMERICAN SPECIES OF THE PARINE GENUS *PSALTRIA*.

By PHILIP LUTLEY SCLATER, M.A., F.Z.S.

In describing a new *Conirostrum* in these 'Proceedings' for last year (P.Z.S. 1855, p. 74), and giving a list of all the species of that form with which I was acquainted, I took the opportunity of noticing some birds which had been referred to the same genus, which I had not then met with. Among these latter was the *Conirostrum ornatum* of Lawrence, described and figured in the Annals of the Lyceum of Nat. Hist. of New York for 1851. It is only lately that I have been successful in meeting with a specimen of this, I believe, rather rare species. As I had always supposed, I find it has nothing to do with the genus *Conirostrum*, but has been much more nearly rightly placed by Sundevall, who described it as *Egithalus flaviceps* the year before Mr. Lawrence's name appeared. In my opinion, however, this latter position is not perfectly satisfactory for it. This little bird in fact seems to me to form a very natural member of the Parine genus *Psaltria*, of which some Asiatic species, including the type, are figured in the seventh Number of Mr. Gould's great work on the Birds of that continent.

Mr. Cassin, in a very useful Synopsis of the North-American *Parinae*, given in his excellent volume on the Birds of California, Oregon, &c., p. 20, mentions two North-American species of this genus, *Psaltria minima* and *P. melanotis*, but says nothing of the present bird, with which he seems to have been unacquainted. Examples of both the former species are contained in the British Museum, and upon comparison agree in every essential character with this bird. It is true that its yellow face and chestnut bend of the wing are quite different in cast of colouring from what we meet with in the other species of this group, and I have little doubt that some naturalists who are fond of coining new names would consider this fact a sufficient excuse for making it the type of a new division. But I do myself think that generic characters ought only to be founded upon differences in structure; and as in the present instance there appears to be none such, I think we shall be quite accurate in registering the present bird as a third American species of the Asiatico-American genus *Psaltria* under the title of

PSALTRIA FLAVICEPS.

Egithalus flaviceps, Sund. Öfvers. af Vet. Ac. Förhand. vii. p. 129 note (1850).

Conirostrum ornatum, Lawrence, Ann. Lyc. New York, 1851, p. 113, pl. 5. fig. 1.

P. fuscescenti-cinereus, subtus dilutior: pileo et gutture flavescens: campteriis clare castaneis: alis caudaque intus nigricanti-brunneis: rostro et pedibus nigris: tectricibus subularibus albis.

Long. tota 4·2, alæ 2·1, caudæ 1·9.

Hab. Texas (Lawrence).

Note.—Since writing the above, I have been enabled through Mr. Gould's kindness to compare *Psaltria flaviceps* with the type of the genus, *Psaltria exilis*, from Java. It certainly offers a more pointed beak and wing not so rounded as the latter bird, and may be considered as rather aberrant in form. Any naturalist, therefore, who is unwilling to class it with true *Psaltria* may use for it the generic term *Psaltriparus*, that name having been bestowed by Prince Bonaparte (Compt. Rend. Ac. Sc. Par. xxxi. p. 478) on *Psaltria melanotis* (Sandbach), with which species this bird agrees in every respect.

ON A PECULIAR VARIETY OF *MUS MUSCULUS*.

BY JOHN S. GASKOIN, F.L.S.

MUS MUSCULUS. Var. *Mus nudo-plicatus*.

I have thus designated this strange and novel form of the genus *Mus*, to give the more importance to the singularity.

In the spring of 1854 a labourer in the employ of Mr. Webster, a tenant on the Taplow-court estate, observed several little white creatures running about a straw-rick in the wood at the back of the lodge near Taplow paper-mills, Maidenhead Bridge, and succeeded in

securing two of them ;—the following day, on moving some of the straw in search of more, he disturbed two others, which he also captured; and disposed of the four to Bond, the Maidenhead Bridge boatman, for five shillings. Two died during the first night, probably from the rough usage they received when taken ; there remained, to use Bond's expression, but "the old buck and a doe big with kit." In seven days she brought forth five young ones ; and the next day removed from the nest two that were dead ; the remainder were reared. One of the existing five was afterwards lost or killed. These little animals were readily recognized as a form of mouse, but of so extraordinary a conformation in their external structure as to attract the curiosity of the immediate neighbourhood, and obtain the not inappropriate name of the rhinoceros mice. The surmise of the people on the spot is, that they had escaped from one of the numerous barges which are constantly arriving at the paper-mills laden with rags, &c., principally of foreign importation. Bond having possessed them four months, offered them for sale to the Zoological Society of London, and the purchase being declined, I bought them, lest so singular a form in natural history should be lost to science and pass into oblivion ; and it is to prevent this, that I now beg to record their characters in the 'Proceedings' of this Society. They were shown at the meetings of this and the Linnean Societies, and to many other naturalists ; and finally, were exhibited during four months in the small-quadruped house in the gardens of the Society, with the view of eliciting information respecting them, as to any similar conformation in the species or genus having before been observed ; and expressions of surprise at their novelty of form were in every instance the only remarks obtained. At the period named of their exhibition all had died. Unfortunately they did not breed, although three of them were born, in captivity.

In size these animals somewhat exceeded the common mouse, measuring from the tip of the nose to the base of the tail $4\frac{1}{8}$ inches ; they were totally destitute of hairs, excepting some two or three dark-coloured labial hairs, or whiskers ; the external integument pinkish white, and formed into coarse prominent plicæ, or duplicatures of itself, transversely traversing the body in an undulated shape, and increasing in width and projection as they descended from the dorsum to the most depending line on either side of the thorax and abdomen, and there forming pendulous flaps, extending from the arm of the fore to the thighs of the hind legs ; so that all the legs being stretched asunder, as when on the wires of the cage, these flaps became expanded in the manner of the flying squirrel. The plicæ or duplications of the skin were on the sides of the body in a degree symmetrical ; and on the face and head particularly so ; the ears of a dark or blackish colour, the tail ash-coloured, and the eyes black, indicating that they were not albinos of the species. It was curious to observe the quickness and dexterity with which their little paws opened along the furrows formed by the plicæ or folds, to clean between them. So dissimilar, it will be observed from the characters given, is the external formation of these animals from that

of the domestic mouse, that opinions were risked as to their constituting a different species, but on investigating the teeth of the first one that died, and they proving identical, it was inferred they are a *lusus naturæ* of that species;—if such, however, be the fact, I believe this will prove the first instance on record in which the whole litter or brood of animals or birds, have all been in exactly the same state of abnormal condition, and that condition becoming permanent, and continued through successive generations; of which we have here the example of two or more generations, and have no knowledge whatever of when this abnormal state may have begun;—for, as in this exemplification, “like begets like”—“*similia similibus gignuntur*,” it is fair to conclude that the two parents whose progeny resembled them, had also progenitors similar to themselves; especially as they in their breeding, like genuine species in the wild state, associated only with those of their own kind; thus, if the race be not extinct, successions with the same peculiarities will be produced, and give rise to a remarkable example of the origin of a new species, or variety of a species, in the genus. I have made inquiries about the locality where these animals were found, as to whether others had ever been observed there before they were discovered, or have been met with since, and find these to have been the only known instances of their occurrence.

I am not aware that in the nests of the Rook, *Corvus frugilegus*, or the Blackbird, *Merula vulgaris* (which I mention as being those in whose productions *lusus naturæ* are the most frequently noticed), or in the nests of any other bird, more than one individual of a brood has been found, constituted in the healthy condition, and having the plumage white, and the red eye of the true albino; but variations in colour, &c., may occur in any number, as the results of physical impediments, and not natural production; however, with increase of strength and health, these generally obtain afterwards their proper-coloured plumage, and are not therefore true *lusus naturæ*. To quadrupeds I believe the rule equally applies.

In consequence of the interesting conversation which followed the reading of the foregoing paper, I think it proper to subjoin a few other observations.

The excellent condition and clean appearance of the animals, and their well feeding and activity, left no doubt as to their healthy state during the six months they were alive in my possession and during the four months they were in that of Bond. A Member present stated, that while they were in the Gardens he had microscopically examined the lamellæ or branuy scales which are ever separating, in larger or smaller particles, from the epidermis of animals, and found them the natural and healthy production. My own examination of these exfoliations had led me to the same opinion. I had the opportunity, and carried my inquiry still further; I carefully examined the surface and sections of the dermoid covering with low and with high microscopic powers, and with transmitted light, and as opake objects, with a view to discover any hair-follicles or

glandular bulbs from which hairs might have emanated, but could not discover a single indication of either, nor any recognizable vestige of their obliteration ;—I therefore believe the organs for pilous production were absent, and *ab initio*. These little animals having been found in a straw-rick, I conclude, will sufficiently indicate their habits and general residence to be similar to those of the common mouse.

Note.—Having recently heard that a specimen of the same variety of *Mus* that I have described is preserved in the Museum of the College of Surgeons, I compared it with the examples I possess, and found it precisely the same in every character ; it was caught by the late Mr. Clift in the fire-place of a room in his house in London, and is entered in the Catalogue of Monsters—"No. 121. A common Mouse (*Mus Musculus*), full-grown, which, from its birth, had not the slightest appearance of hair on its skin, being perfectly naked. Presented by Mr. Clift, 1820."

DESCRIPTION OF THE ANIMALS AND TEETH OF TYLODINA AND OTHER GENERA OF GASTEROPODOUS MOLLUSCA.

By DR. JOHN EDWARD GRAY, F.R.S., V.P.Z.S., P.B.S. ETC.

In the following paper I forward the description of the animal and the teeth of several genera of Mollusca which have not yet been recorded. It is interesting to find that the examination of the teeth justifies the position which was theoretically assumed for the genera in the different families before their teeth were known.

A. PROBOSCIDIFERA HAMIGLOSSA.

Fam. MURICIDÆ.

FUSUS PALLIDUS ("*F. turbinelloides* = *Pyrula lignaria*, Reeve").

The proboscis elongate, cylindrical, subclavate, entirely retractile ; the lingual membrane elongate, narrow, yellow ; teeth in three longitudinal series, 1·1·1, the central transparent, provided with a rounded front edge, armed with three rather elongate, conical, subequal denticles ; the lateral teeth yellow, versatile, straight, with two compressed arched processes, the terminal one largest, the basal rather smaller, and with a small tooth on its outer edge. The operculum is horny, thick, ovate, subtrigonal, annular, as large as the mouth of the shell ; the apex blunt, rather worn ; the nucleus apical, scar large oblong, with a thick callous exterior margin.

TYPHIS TETRAPTERUS.

Operculum horny, ovate, blunt, laminar ; nucleus anterior, apical, as large as the mouth of the shell, rather broader behind.

PISANIA ELEGANS. Panama.

The animal pale brown (in spirits) ; the foot folded up and across behind, and together longitudinally in front, leaving a J-shaped groove ; tentacles very small ; proboscis elongate, thick, clavate, entirely retractile ; lingual membrane elongate, thin ; teeth in three

longitudinal rows, 1·1·1, central far apart from each other, and the lateral teeth, lunate, with a slightly denticulated, nearly straight, front edge, and a rather strong concave tooth at each end; lateral teeth versatile, large, with a nearly equal basal and apical, conical, curved process. Male organ slender, elongate, tapering, yellow, compressed. Operculum ovate, acute, thick, horny, annular, nucleus apical.

TRIUMPHIS DISTORTA. Panama.

Lingual membrane elongate; teeth in three longitudinal series, 1·1·1; central teeth very small, far apart; lateral large, versatile, with two basal unequal, and one larger terminal curved process. Operculum ovate, acute, very thick.

CYCLOPE (NASSA) NERITINEA.

Nucleus prominent above the surface of the apex of the semi-adult shell, turritid, spiral, dextral, of three or four transversely sulcated flat whorls, with a blunt tip, at length deciduous, leaving a flat, spiral, rather callous scar. The whorls of the shell of the hatched animal suddenly enlarged, thick; smooth, spotted, forming a sudden contrast to the whorls of the nucleus.

Risso formed a genus, name *Nanina*, from the young state of the shell.

Fam. BUCCINIDÆ.

CUMA SULCATA.

Operculum horny, ovate, triangular, with a deep notch on the middle of the broad side, with a broad callous margin on the inner angular edge of the inner surface. Body and foot with a deep groove on the inner side, formed by the fold on the inner lip of the shell, like the notch in the operculum; foot folded up behind and together in front, forming a J-shaped groove, with a cross groove in front; tentacles close together at the base, diverging, short, compressed, sharp-edged, eyes on the outer side near the tips, which are more slender and acute above them; proboscis moderately elongate, cylindrical, subclavate, completely retractile; lingual membrane very narrow and elongate, horny; teeth dark-coloured when adult, in three longitudinal series, 1·1·1; the central teeth broad, transverse, about half the width of the lingual membrane, with seven distant conical denticulations on the front edge, the central denticle forming a continued central ridge, the lateral denticulations unequal, the central of the three larger, the outer one on the outer margin of the tooth; the lateral teeth small, conical, curved, acute, versatile with a simple rather elongate base.

B. ODONTOGLOSSA.

Fam. FASCIOLARIADÆ.

FASCIOLARIA SALMO.

Operculum ovate, acute, smooth, slightly concentrically wrinkled; apex of this individual reproduced and rather rounded. Animal bright
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red; foot, when contracted, folded together transversely behind and longitudinally in front; tentacles small, compressed, subulate, united together at the base, forming a small veil; eyes on the outer side, rather above the base, with a conical tentacle only slightly produced above the eyes; proboscis very long, slender, entirely retractile; lingual membrane very long, slender, with three longitudinal series of teeth in cross lines, $1 \cdot 1 \cdot 1$, the central teeth narrow, square, with three small, subequal, acute denticulations, the central one rather the longest; the lateral teeth very broad, slightly arched, and more arched at the outer end, with a series of twenty-five or thirty equal, regular, elongate, subulate teeth, somewhat like the teeth of a coarse hair-comb; the central teeth are opposite the space between the lateral teeth, that is, alternating with them. Male organ elongate, subcylindrical, compressed, of the same diameter the whole length, rounded at the end with a slight groove on its outer edges, which is not continued up the body as in *Malea*.

LEUCOZONIA ANGULATA.

Animal red; the foot, when contracted, folded up across behind, and longitudinally in front, leaving a J-shaped groove; tentacles close together at their base, diverging, flat, with the eyes on the outer side rather below the tip, which is narrower and acute; proboscis completely retractile, clavate; lingual membrane elongate, rather narrow; teeth in three longitudinal series, the central series rather narrower than the lateral ones, square, with a rather arched anterior edge, with elongate, conical, acute denticulations, the central denticulation being the largest and longest; the lateral teeth bandlike, rather oblique, front edge with several distinct, conical, acute denticulations, the one at the edge of the inner margins near the central tooth being much the largest and longest; operculum ovate, acute, thick; nucleus apical.

C. TÆNIOGLOSSA.

Fam. DOLIIDÆ.

The proboscis of this family is very long, large, and more or less dilated, with an open rather trumpet-like mouth at the end.

MALEA RINGENS.

Animal like *Dolium*. Lingual membrane narrow, elongate, wider in front; teeth in seven longitudinal series, dark red, in each cross series, $3 \cdot 1 \cdot 3$; the central teeth broad, lunate, thin, with a central recurved apex, and sometimes a small denticle for each side, halfway between the tooth and the end; the lateral teeth subulate, curved, acute at the top; cervical collar of two ovate, horny plates, covered with crowded converging subulate teeth; foot short, truncated in front, rounded behind; proboscis cylindrical, large, retractile into a sheath under the tentacular veil; mouth open at the end; tentacles subulate; eyes on short tubercles at the outer hinder side. Male organ very large, compressed, with marginal groove on the outer side, continued up the right side of the body by the side of the rectum,

and with a slender filiform appendage near the tip. Operculum none.

FAM. TRITONIADÆ.

The animals of this family are intermediate in character between the *Probosciferæ* and the *Rostriferæ*. The proboscis is larger and thicker than in the other families of the *Probosciferæ*, is not so much retracted, and is contained in a more free sheath, and the end of the retracted trunk is often partly exposed beyond the margin of the sheath, giving the animal somewhat the external appearance of the *Rostriferæ*, and explaining why some of the French figures of the animals of *Triton*, *Ranella*, &c. are represented as if they belonged to that division of the Gasteropods.

RANELLA CÆLATA.

Tentacles lateral, separated by a short, rather broad, truncated tubular veil; eyes on the outer side rather above the base; proboscis short, very large and thick, retracted to the edge of the veil, leaving the two rounded pale processes of its apex exposed, forming with the veil a rostrum-like projection, very unlike the elongate, slender, cylindrical retracted proboscis of *Murex*, *Purpura*, &c.; lingual membrane narrow, elongate; teeth in seven series, 3·1·3, close together, rather crowded, the central rather narrow, with a central prominent deucle, having a smaller one on each side of the base; the lateral teeth subulate, curved.

SCUTIBRANCHIATA RHIPIDOGLOSSA.

FAM. TURBINIDÆ.

IMPERATOR, n. s.? Panama.

Eye-pedicel thick; tentacles elongate, slender; frontal lappets truncated, broad at the base, about $\frac{1}{2}$ the width of the forehead; foot folded longitudinally behind and transversely in front; lateral fringe of the right side most distinct; muzzle produced, annulated; lingual membrane elongate, rather narrow, linear, dark brown; central teeth 5·1·5, the middle one broad, the side ones narrower, square, all with a recurved tip; the lateral teeth numerous, hairlike, the inner one wider.

CALLOPOMA SAXOSUM. Panama.

Foot folded across in the middle; back with a hoodlike process covering the front part of the operculum, and depositing the external callosity of it; eyes on short thick pedicels; tentacles linear, at the upper edge of the eye-pedicel; frontal lappet truncated, narrow at the base, at the inner side of the base of the tentacles; lateral fringe on each side, with three beards on the middle of the edge; lingual membrane broad, elongate; central series 5·1·5; the central broad, with a recurved tip, the lateral one more narrow, equal; the lateral teeth numerous, hairlike.

Fam. TROCHIDÆ.

TEGULA PELLIS SERPENTIS. Panama.

Operculum horny, thin, orbicular, of many narrow, gradually enlarging whorls; foot folded together longitudinally when contracted; eyes on thin elongated pedicels; tentacles linear, sheathed at the base by the inner part of the base of the eye-pedicels; frontal lappet none; lateral fringe of left side distinct, with three beards just beneath it; lingual membrane elongate, broad; teeth in ten longitudinal series, in arched cross rows, elongate, with a rounded apex; lateral teeth linear, crowded, arched at the end.

Order PLEUROBRANCHIATA.

Fam. APLYSIADÆ.

APLYSIA DEPILANS? Genoa.

The small, polished, subglobular spiral (sinistral?) nucleus or apex of the older shell is, with the subapical part of the shell, covered with a membranaceous reflection of the inner lip over its surface, which is only slightly adherent to the surface of the shell and nucleus, and easily removed from it, but which gradually becomes thicker; the top of the shell appears to be absorbed, or more or less obliterated in the older specimens.

According to Mr. Woodward, Mr. Hancock has observed in the adult specimen two or three shells one within the other, like the *Loligines* or *Sea slaves*.

Fam. TYLODINADÆ.

TYLODINA PUNCTULATA = *T. Rafinesquii*, Philippi.

Lingual membrane very broad, brown; teeth small, uniform, very numerous, in very numerous longitudinal lines, forming straight continued uniform lines across the membrane, with an indistinct central line; the tentacles subulate, slit on the outer side; the lips are produced and acute on each side, and twisted, leaving a slight cavity on the outer side of the tip; the mantle is thin, free all round the edge and slightly thickened just within the margin, rather thicker and more free over the front of the back; the gill is single on the hinder part of the right side just under the mantle, attached the whole of its length on the inner side by a central ridge to the side of the body; the outer side is furnished with a rather thick, somewhat zigzag central vessel, giving out pinnated vascular branches, nearly alternating with each other on each side of the great vessel; the foot is larger than the mantle and shell, expanded, rounded behind, truncated in front and slightly emarginate in the centre under the mouth; the sexual aperture not visible in the specimen in spirits. Shell conic, patelloid, thin, slightly pearly within, with a thin, hard, horny periostraca, which is produced beyond the edge of the shell, and radiately coloured, in the dry state brittle, hard, and contracted; the apex (of the shell) subcentral, with a rather produced polished top, nucleus subglobose, with a slightly convex spire

of one and a half or two rapidly enlarging subconvolute whorls ; aperture ovate, rather irregular, slightly dilated on the right side ; cavity simple ; muscular scar subannular, with an angular inflection rather behind the middle of the right side, the form of the scar is variable, sometimes square, broad all round ; in the larger, more developed specimens the scar is rather horse-shoe shaped, being somewhat dilated at the front part of each side, and the front portion over the back of the head is narrow, linear, and transverse.

The genus was first established by Rafinesque in 1814 ; Blainville, who only knew it from Rafinesque's imperfect descriptions, referred it to the *Patellouda*, but Menke, Philippi and Cantraine properly considered it allied to *Pleurobranchus*, and especially *Umbrella*, and very lately Dr. Lovén stated that it was allied to *Turbonella* (Index Moll. Scand. 19). The examination of the teeth proves it to belong to the typical *Pleurobranchiata*, and the form and position of the gill shows its affinity with the genera *Pleurobranchus* and *Umbrella* ; indeed it chiefly differs from the former genus in having an external conic patelloid shell, and from the latter in the head being produced and the mouth not sunken in a deep anterior pit.

In the British Museum there are two species of this genus.

1. *T. punctulata*, Rafin., *T. Rafinesquii*, Philippi, *T. citrina*, Joannis, Guérin, Mag. Zool. i. t. 36.

Shell thin, whitish ; periostraca hard, opaque, with dark brown rays. Mediterranean.

2. *T. atlantica* = *Umbrella mediterranea* ? MacAndrew, Ann. Nat. Hist.

Shell solid, bright yellow ; periostraca — ? N. Atlantic, Madeira.

Fam. UMBRELLADÆ.

UMBRELLA MEDITERRANEA.

The nucleus of this genus is very like that of *Tylodina*, subglobose, polished, sinistral, of one and a half or almost two subcylindrical, rapidly enlarging whorls ; the adult shell is irregular in the outline and rather expanded on the hinder part of the right side, over the gills ; the muscular scar is annular, continued, and of nearly uniform breadth, but slightly interrupted in various parts. The chief difference between the shell of *Tylodina* and *Umbrella* is, that the shell of the former is more elevated, very thin, covered with a hard, rather paleaceous periostraca, and the muscular scar is furnished with an angular inflation on the hinder parts of the right side ; a sinistral nucleus is found on several others ; shells as in the genera of *Pyramidellidæ*.

Fam. PROSERPINIDÆ.

PROSERPINA.

Respiratory cavity open ; mantle free from the back of the neck, with a double edge, the outer one rather reflexed ; foot moderate,

truncated in front, acute, and keeled above behind; muzzle short, truncated, annulated, with a triangular inferior mouth; tentacles 2, lateral, far apart, tapering and acute; eyes moderate, sessile, at the outer side of the base of the tentacles; the front part of the back of the foot concave, surrounded by a continuation of the mantle, forming a fleshy submarginal fringe, which is fuller (when contracted in spirits), crumpled and folded on itself on the left side. Operculum none.

MISCELLANEOUS.

PORTRAIT OF DR. JOHNSTON.

IN our Number for September 1855, we gave a short notice of the life and labours of Dr. George Johnston of Berwick-upon-Tweed, who was one of the Editors of this Journal from its commencement to the day of his death. Although so long a time has elapsed since the lamented decease of this distinguished zoologist, we hope that the excellent portrait of him which we have the pleasure of presenting to our readers as the FRONTISPIECE to the present volume of the 'Annals' may not prove unacceptable. Those who were acquainted with the late Dr. Johnston will recognize in it an excellent likeness of that amiable and talented naturalist, in which even the benignity of expression which peculiarly characterized him has been most faithfully preserved.

The portrait, which is copied from an excellent daguerreotype by Mr. Claudet, taken in 1850, was kindly lent to us for this purpose by Dr. Gray of the British Museum, and has been executed by Mr. Robert Hicks. It is admirably done, and ought to add greatly to the reputation of this talented young engraver.

On the Occurrence of some new species of Pollicipes in the Inferior Oolite and Lias of Gloucestershire. By the Rev. P. B. BROWN, M.A., F.G.S.

Mr. Darwin in his valuable and interesting Monograph on the Fossil Lepadidæ, published in the Memoirs of the Paleontographical Society for 1851, observes, that "the oldest known pedunculated Cirripede is a *Pollicipes*, discovered by Professor Buckman in the Stonesfield Slate." Since the publication of Mr. Darwin's memoir, I discovered the remains of a *Pollicipes* in the Inferior Oolite at Selsley Hill near Stroud, in Gloucestershire, a locality which has afforded many new and interesting fossils, for which we are indebted to the able and active researches of my friend Mr. Lycett.

Two valves of the scutum are entire, but the other three are too fragmentary to decide to which of the other valves they may have belonged. On comparing the scutum with the same valve in *Pollicipes ooliticus*, of the Stonesfield Slate, there is a marked difference

between them, so that, in all probability, this will prove to be a distinct species; but this I hope Mr. Darwin will be able to determine.

Another and probably a different species has been found by Mr. Gavey at Chipping Campden in Gloucestershire, in the top beds of the lower Lias, which are very prolific in organic remains wherever they occur. As the Cirripedes are usually rare in a fossil state, especially in the Oolites and Lias, it seemed desirable to notify the existence of some species of Lepadidæ during these geological periods, — a somewhat earlier date than the one previously indicated.

MR. YARRELL'S COLLECTIONS.

Our readers will be gratified to learn, that the Trustees of the British Museum have secured for the Museum the collection of British Fish, and all the specimens of Birds and other animals illustrating Mr. Yarrell's various papers in the Transactions of the Linnæan and Zoological Societies, at the sale of his property.

On the Stereognathus Ooliticus, from the Stonesfield Slate.

By Prof. OWEN, F.R.S., F.G.S.

The subject of this paper was a small mammal, represented by a fragment of a lower jaw retaining three molar teeth, which was obtained by the Rev. J. Dennis from the Stonesfield-slate of Oxfordshire, and named *Stereognathus Ooliticus* by Mr. E. Charlesworth. This specimen, described in detail by Prof. Owen at the British Association Meeting in September last, indicated, in the author's opinion, an animal allied to some extinct genera of even-toed Pachyderms, viz. the *Hyracotherium*, *Microtherium*, and *Hyopotamus* of the Tertiary deposits; and he concluded therefore that the *Stereognathus* was most probably a diminutive non-ruminant Artiodactyle of omnivorous habits.

With regard to the zoological reasons for referring this peculiar and ancient fossil to the type of animal form above alluded to, the Professor entered at some length into the analysis of the mental processes by which the palæontologist aims at the restoration of an unknown mammal from such a fragment as the fossil under notice. Its mammalian character is decided by the two-fanged implantation of the teeth, and its pachydermatous affinities are evidenced by the peculiar sex-cuspid and cingulated molars. These zoological relations are determined from the knowledge that such structural peculiarities obtain in certain known Pachydermata. Morphology, therefore, or the study of form, rather than physiology, or the known relation of organs to function, is the guide in this determination; but the Professor expressed his opinion that this example could not be cited as showing that there is no physiological, comprehensible, or rational law (in contradistinction to the morphological or empirical) which can be a guide in the determination of fossil remains.

He did not think that all such determinations rest upon the application of observed coincidences of structure, for which coincidences no reason can be rendered; for, although in many instances of this law of correlation, as demonstrated by comparative anatomy, the sufficient or physiological cause of them is not known; yet, in other instances, the application of the principle has been successfully illustrated. The truth or fact (said Prof. Owen) of a physiological knowledge of a correlated structure, and of the application of that knowledge to palæontology, is not affected or destroyed by instances adduced from that much more extensive series of correlated structures of which the physiological condition is not yet known.—*Proc. Geol. Soc.* Nov. 5, 1856.

Note on Estheria minuta. By T. RUPERT JONES, Esq.,
Assist. Sec. G.S.

Not long since the Rev. W. Symonds favoured me with some well-preserved specimens of this little Triassic fossil; and, with Prof. J. Quckett's kind assistance, I was enabled to see most distinctly the true Crustacean character of the tissue of its valves. This confirmed an opinion I had long held that this fossil is not a Mollusk, but closely allied to the *Limnadia*, *Limnetis*, and *Estheria**, bivalved phyllopodous Crustaceans (*Entomostraca*) of the present day; and indeed, as far as the carapace-valves are concerned, it well represents the *Estheria* of Rüppell and Baird † (*Isaura*, Joly).

In the Quart. Journ. Geol. Soc. (1847) vol. iii. p. 274, Sir C. Lyell figured a similar fossil from the coal-shales of Eastern Virginia, and remarked that, with Mr. Morris, he doubted whether the so-called "*Posidonomya*" may not be a Crustacean rather than a Mollusk ‡. Similar fossils, of different species, occur in the Devonian rocks (Caithness and Orkney), Carboniferous (Northumberland), Liassic (Skye and Gloucestershire), Oolitic (Scarborough), Purbeck (Dorset), and Wealden (Sussex). Others are met with in the Jurassic Coal-fields of North Carolina and Virginia §, and along their north-eastern extension, forming the so-called "New Red Sandstone" of Virginia and Pennsylvania ||; in the plant-bearing sandstones of Central India ¶ (Nagpur and Mangali); and in the Triassic deposits of Europe.

* This is the little Triassic shell that has been termed *Posidonia* and *Posidonomya minuta*: *Posidonia minuta*, (Alherti) Goldfuss, *Petref. Germ.* p. 118. t. 113. f. 5; *Posidonomya minuta*, Bronn, *Leth. Geog.* p. 164. t. 11. f. 22; Zieten, *Verat. Württemb.* p. 72. t. 54. f. 5; Strickland, *Geol. Trans.* 2 ser. vol. v. p. 338. t. 28. f. 4. In Morris's 'Catalogue of British Fossils,' 2nd edit. 1854, it is included in the *Crustacea* (as *Estheria minuta*); but (apparently from inadvertence) it has not been expunged from the list of Mollusks in that work.

† *Proc. Zool. Soc.* part 17. p. 86.

‡ See also Lyell's 'Manual of Geology,' 5th edit. p. 332.

§ Lyell, *loc. cit.*; and W. B. Rogers, *Boston Nat. Hist. Soc. Proc.* v. p. 15.

|| Continuous with the Sandstones of New Jersey, and most probably with those of Connecticut also: Rogers, *loc. cit.*

¶ *Quart. Journ. Geol. Soc.* vol. xi. p. 370.

Although occurring so constantly in the different geological periods, from the Devonian to the Wealden*, and again in the recent marine and fresh waters, yet it is in the Triassic deposits of England and the Continent, in the sandstones and shales of Virginia and Pennsylvania, and in the plant-bearing beds of Virginia and Central India, that this little bivalved Entomostracan appears to be pre-eminently abundant; so as to serve probably as a faithful index of a peculiar geological horizon†.

In like manner, among the still lower forms of life, the Nummulite is represented in the Silurian‡, Carboniferous, Liassic, and Oolitic rocks, and exists also at the present day; but it particularly distinguished one epoch (the Tertiary) by a surprising fecundity and a temporary profusion of individuals.

The occurrence of a fossil *Estheria* in the Upper Sandstone and Shale of the Scarborough district (*E. concentrica*, Bean§, sp.) is of interest, as being indicative of the association of this Crustacean with the Oolitic flora in England, as it is in India and America.

In India a Triassic Labyrinthodont Reptile (*Brachiops laticeps*||) is found in the same strata as yield the *Estheria* at Mangali and the plants at Nagpur; and in Pennsylvania reptilian remains¶ occur with the so-called "Posidonia": in America indeed the evidence seems to point to a contemporaneity of the Virginian plant-beds, the shales and sandstones of Pennsylvania and New Jersey, the foot-marked sandstones of Connecticut, and the upper red sandstone of Nova Scotia and Prince Edward's Island, which is also reptiliferous** ; and it is evident that in the Virginian and Pennsylvanian shales the minute Crustaceans under notice are important fossils. The plants of Nagpur and Virginia having a Jurassic facies, like those of Scarborough, it will be interesting, as further evidences turn up, to see how far we are to regard the Triassic or the Jurassic element as preponderating, or whether a passage-group of deposits are indicated by the evidence,—or, lastly, whether these Plant-beds with Reptiles and Crustaceans indicate the terrestrial and lacustrine conditions only of the early secondary period.

The Jurassic flora of Australia†† and that of Southern Africa have been hitherto collected without affording any clear traces of the *Estheria*. The latter country, however, has its probably Triassic

* I have no satisfactory evidence of the presence of the genus in question in the Cretaceous and Tertiary deposits.

† Prof. W. B. Rogers has already pointed out (*loc. cit.*) the probable value of this little fossil in the comparison of the Mesozoic rocks of North Carolina and Virginia, and of these with the so-called Triassic beds of the United States.

‡ *Annals and Mag. Nat. Hist.* ser. 2. vol. xv. p. 58.

§ *Mag. Nat. Hist.* ix. p. 376.

|| *Quart. Journ. Geol. Soc.* vol. ix. p. 37 & 371.

¶ Lea on *Clepsydrus Pennsylvanicus*, *Journ. Acad. N. Sc. Philad.* n. s. vol. ii. p. 166; and on *Centamedon sulcatus*, *Proc. Ac. N. Sc. Philad.* vol. viii. p. 77.

** Leidy on *Bathynathus borealis*, *Journ. Acad. N. Sc. Philad.* n. s. vol. ii. p. 327.

†† See McCoy's paper, *Annals and Mag. Nat. Hist.* vol. xx. p. 145, &c.

Reptile, the *Dicynodon*, imbedded with this flora* ;—so that the peculiar association above-indicated for India and North America obtains there also.

In pointing out these facts of the geological and geographical distribution of the fossil *Estheria*, I merely touch upon the salient points of an interesting subject of research,—for the elucidation of which careful inquiry at home and abroad is still requisite.

In conclusion, although the recent *Estheria* is a marine Crustacean, yet, since very closely allied forms are of freshwater habits, and since among bivalved Entomostracans different species of a genus and even the individuals of a species occasionally live either in marine or in fresh water, there is no *certain* evidence afforded by the fossil in question whether the so-called 'Triassic deposits in which it is found were formed in rivers, lakes, or seas.—*Journal of the Geological Society* for November 1856.

On the Genus Cuma. By C. SPENCE BATE, F.L.S.

The study of the *Diastylidæ* certainly led in my mind to a very different conclusion from that which, judging from the remarks in the September Number of Silliman's *Journal*, it has produced in Prof. Agassiz'. I think, moreover, that since he admits the *Diastylis Rathkii* to be an adult animal, because it has been taken with young, he must have overlooked Mr. Goodsir's statement, that he had taken *Cuma Scorpioideus*† (Mont.) with spawn (ova), which he describes as very large and of a bright straw colour. This appears to be an argument of equal force to prove that *Cuma* is adult.

In my humble judgment, the fact of Prof. Agassiz having taken his specimens from *Macroura*, is evidence that they could not be *Cumæ*—that is, the genus of Edwards and Goodsir.

With regard to the affinity between the young of *Macroura* and *Cuma*, I append a portion of an interesting letter which I received from B. Q. Couch, Esq., whose knowledge of the larval forms of the decapod Crustacea is second to no living carcinologist. I have taken the liberty to italicise one passage :—

"Penzance, August 11th, 1856.

"I have been very much occupied on the larval state of our decapod Crustaceans, in furtherance of a re-examination of the whole subject. It cannot be a matter of surprise that the genera *Cuma*, *Alauna*, *Bodotria*, &c. should *à priori* be thought to be the young of the higher Crustacea. I confess I suspected it myself for some time, but gave it up many months ago, and my opinions are fully confirmed by the valuable observations in your paper. My views were grounded on the fact, that *I never met with any of these forms*

* *Trans. Geol. Soc.* 2nd series, vol. vii. part 4. p. 227, note.

† It must be remembered that in the species *Cuma Scorpioides* of Montagu, I have included the *C. Audouinii* of Edwards and the *C. Edwardsii* of Goodsir.

in any of the larval conditions of the Crustacea of Cornwall, though the number I have examined is great.

"Even the alternations of generations will not serve in this matter; for if I understand aright, you have examined the young and find them like the adult, while I have examined the great majority of our Decapods without once detecting the strange forms of these genera among them.

"Agassiz' assertion must be taken with limitation, or he has been altogether deceived, so far as British observations would indicate.

"I have carefully examined the *Zoe* condition of *H. varians*, *Prideauxiana*, and *Cranchii*, and find they are all totally unlike *Cuma* and the kindred genera. We must not generalize too quickly. Agassiz' specimens, it must be remembered, were American; still I should not expect that kindred species would differ so widely as they must, if his observations are correct."

RARE BRITISH BIRDS.

To the Editors of the *Annals of Natural History*.

Falmouth, December 13, 1856.

GENTLEMEN,—On Thursday last, a specimen of the *Thalassidroma Leachii*, Selby, in an exhausted state, was captured by a shipwright near the bar. It is in the possession of Mr. Chapman, taxidermist. Two specimens of the *Lutra vulgaris*, Desm., were shot by Mr. Wm. Holder, at the Swanpool, on Wednesday night last. One measured 4 feet long, and weighed 21 pounds; the other 3½ feet long, and 16 pounds.

I am, Gentlemen, yours truly,
W. P. COCKS.

Note on Zootoca vivipara v. nigra, Gray, *Cat. Rept. B. M.* 28.

Mr. Thomas Hopley has lately presented to the British Museum a black specimen of *Zootoca vivipara*, which was caught by a young friend, Mr. Fritz Noel Mackay, near Eastbourn, Sussex.

Mr. Hopley states that the variety is permanent in that neighbourhood, but nowhere common.

The Black Lizard has only hitherto been recorded in our fauna as found in Ireland. It is not uncommon in some districts in Germany, but appears local.

It is regarded as a distinct species by Wolf, and well figured under the name of *Lacerta nigra* in Sturm's beautiful 'Fauna Germanica.'
—J. E. GRAY.

On a new Turkey, Meleagris mexicana.

By J. GOULD, Esq., F.R.S. &c.

In the lapse of time the origin of several of the animals which man has subjected to his dominion, and which are of the greatest service

to his necessities or his pleasures, has become involved in obscurity. As instances in point we may cite among quadrupeds the Camel, the Horse, the Dog, &c., and among birds the various *Gallinacæ*, *Anatidæ* and *Columbilæ*, all of which were derived from Asia. The productions of the New World have not yielded such ready obedience to his sway, since no one of its quadrupeds has yet been domesticated, and only one of its birds—the Turkey; but a like fate, if I mistake not, has attended the origin of this solitary acquisition, which, although the bird has not been known to us more than 300 years, is equally wrapped in uncertainty.

"So involved in obscurity," says Mr. Martin, "is the early history of the Turkey, and so ignorant do the writers of the sixteenth and seventeenth centuries appear to have been about it, that they have regarded it as a bird known to the ancients by the name of 'Meleagris,' namely, the Guinea-fowl or Pintado, a mistake which was not cleared up until the middle of the eighteenth century. The appellation of Turkey which the bird bears in our country, arose, according to Willoughby, from a supposition that it came originally from the country so called. Mexico was first discovered by Grijalva in 1518. Oviedo speaks of the Turkey as a kind of peacock abounding in New Spain, which had already, in 1526, been transported in a domestic state to the islands and the Spanish Main, where it was kept by the Christian colonists. It is reported to have been introduced into England in 1524, and is enumerated as among the dainties of the table in 1541. In 1573 it had become the customary Christmas fare of the farmer." Every author who has written on the subject since the days of Linnæus has considered it to be derived from the well-known wild Turkey of North America, but on account of the great differences which are met with among our domestic Turkeys, and the circumstance of the wild Turkeys recently imported from North America not readily associating or pairing with them, I have for some years past entertained a contrary opinion. This opinion may be met by some persons with the remark, that similar and even greater differences occur among our domestic poultry. True—but I believe that these differences are due to an admixture of two, three, or more species, and that in no case would the domestication of a single species produce characters so decided as those exhibited by the two birds now exhibited.

In Canada and the United States the Turkey is partially migratory, visiting those countries during the summer, for the purpose of breeding, and although some writers state that it is a native of Mexico, I can hardly think it likely that it ranges very far south in the latter country, for, from the southern boundary of Canada to Mexico is nearly 2000 miles, and it is unlikely, I think, that a bird of the cold regions of Canada should also be indigenous to the hotter country of Mexico, whence, and not from North America, the Turkey was originally introduced into Europe by the Spaniards early in the sixteenth century.

Believing this bird to be distinct from the North American species,

it becomes necessary that one of them should receive a new name, and a question then arises to which of the two should it be given. My opinion is, that it will be better to retain the term *Gallopavo* for the North American species, and to call the present one *mexicana*, after the country of which it is a native. Linnaeus' *Meleagris Gallopavo* is founded upon the *Gallopavo sylvestris* of Brisson's 'Ornithologie,' vol. i. p. 162, and upon Ray's New England Wild Turkey, both of which names appertain to the North American species; consequently the term *mexicana* would be a fit appellation for the present bird. I may mention, that it is the only example of a Turkey I have ever seen from Mexico, and that it was brought to this country by the late Mr. Floresi, a gentleman whose energy as a collector was only equalled by the honourable career of a moderately long life, during which he was connected with the Real del Monte mines in Mexico. Mr. Floresi travelled himself, and kept collectors, who penetrated into the remotest parts of that country; and many were the fine species he by this means communicated to the world of science. I may mention the splendid *Picus imperialis*, *Calurus neoxenus*, and many Humming Birds, as some of the species which but for his researches would have been unknown to us.

In size this new Turkey exceeds that of the largest specimens of the North American species; but it has shorter legs, a considerably larger and more broadly expanded tail, conspicuously zoned with brown and black, and terminated with white; the tail-coverts are very profusely developed, largely tipped with white, and bounded posteriorly with a narrow line of black, their basal portions being rich metallic bronze. The same arrangement of colouring also prevails on the feathers of the lower part of the flanks; and on the under tail-coverts, where it is particularly fine; the centre of the back is black, with green, purplish and red reflexions; the back of the neck, upper part of the back, and shoulders, are in some lights bronzy, in others the colour of fire; the greater wing-coverts are uniform bronzy brown, forming a conspicuous band across the wing; all the primaries are crossed by mottled bars of blackish brown and white, freckled with brown; all the under surface is fiery copper, intensely brilliant in certain lights, and becoming darker towards the flanks.

Total length 4 feet 4 inches; bill $2\frac{1}{2}$ inches; wing $21\frac{1}{2}$ inches; tail 16 inches, and when spread about 24 inches across; tarsi $6\frac{1}{2}$.

In the Report of an expedition down the Zuni and Colorado Rivers by Captain L. Sitgreaves, lately published in America, the following passage occurs at p. 94, in reference to Wild Turkeys:—

"They are also found in New Mexico, in the neighbourhood of the copper-mines. I am told by our officers that those found there are of enormous size. Mr. Leroux, our guide, informed me that the Turkeys of the Gila River were different from those found east of the Rio Grande, and that they have much white about them."

These are doubtless identical with the bird under consideration.

Since the above remarks were in type, I have been informed by J. H. Gurney, Esq., M.P., that he some years since received the skin of a Wild Turkey from the neighbourhood of the Real del

Monte mines in Mexico, which he considers to be the same as the bird above described; this specimen is now in the Museum at Norwich.—*Proc. Zool. Soc.*, April 8, 1856.

Description of a new Trogon and a new Odontophorus.

By JOHN GOULD, Esq., F.R.S., &c.

TROGON AURANTIIVENTRIS, Gould.

Male: Forehead, face and chin dull black; head, sides of the neck, breast, back and upper tail-coverts golden-green; wings slaty-black, the coverts and secondaries finely freckled, and the primaries margined at the base with white; two centre tail-feathers bronzy-green, narrowly tipped with black; the two next on each side bronzy-green on their outer webs, the inner webs and the tips black; three outer tail-feathers on each side black, crossed by numerous narrow bars of, and narrowly tipped with, white; under surface rich orange, separated from the green of the chest by a semilunar mark of white; thighs black; bill orange; feet dark grey.

Total length, 10 inches; bill, $\frac{3}{4}$; wing, $5\frac{1}{2}$; tail, 6.

Female: Head, all the upper surface and breast orange-brown; wing-coverts brown, minutely freckled with brownish-black; abdomen pale orange; two central tail-feathers reddish-brown, narrowly tipped with black; the two next on each side brown on their outer webs, the interior webs and tips black; three lateral feathers black at the base, their outer webs and apical portions white, minutely freckled with black, and a narrow irregular band of black near the tip.

Hab. near David, Veragua.

Remark.—This species is very closely allied to *Trogon puella*, being precisely similar in every character, except that of the colouring of the breast, which is orange instead of scarlet; both these species are remarkable for the regularity of the markings of their tail-feathers, and for the markings extending to the tip.

ODONTOPHORUS VERAGUENSIS, Gould.

Male: Crown of the head and crest dark rust-red; throat black, with a line of white down the centre of each feather; back reddish-brown, freckled with black, and a faint line of white down the centre of each feather; wings brown, mottled and freckled with black, and with a small indistinct spot of buff near the tip of each of the coverts; scapularies brown, with a light stripe down the centre, and with a large blotch of brownish-black near the apex of the inner web; rump pale brown, obscurely spotted with black; under surface light chocolate-brown, with a spot of white more or less encircled with black near the tip of each feather.

Female: Differs in having the forehead and upper feathers of the crest slaty-brown; and the spots on the breast smaller and less conspicuous.

Total length, 10 inches; bill, $\frac{3}{4}$; wing, $5\frac{1}{2}$; tail, $2\frac{1}{2}$; tarsi, $1\frac{1}{4}$.

Hab. Veragua.

Remark.—This species is nearly allied to *Odontophorus guttatus*, but differs in the lighter colouring of the breast and the redder hue of the crest. Specimens were procured by Dr. Seemann at Panama, and by Mr. Bridges from near David in Veragua.—*Proc. Zool. Soc.* May 13, 1856.

METEOROLOGICAL OBSERVATIONS FOR NOV. 1856.

Chinwick.—November 1. Uniform haze: cloudy. 2. Foggy: cloudy: hazy. 3. Uniformly overcast: very fine. 4. Foggy: very fine. 5. Foggy: light clouds: fine: frosty. 6. Frosty, clear and cold: cloudy. 7. Cloudy: overcast: densely clouded. 8. Densely clouded: rain. 9. Clear: cloudy and fine. 10. Slight rain. 11. Fine, but cold: cloudy and cold. 12. Cloudy: white clouds and clear intervals. 13. Fine, but cold: rain. 14. Clear and cold. 15. Frosty: fine: slight rain. 16. Clear and frosty: fine: sharp frost. 17. Frosty and foggy: dense fog throughout. 18. Slight fog: very fine: rain. 19. Rain: very fine. 20. Densely clouded. 21. Drizzly: hazy: cloudy. 22. Overcast: cloudy and mild. 23. Uniformly overcast: cloudy and fine. 24. Cloudy and fine. 25. Densely overcast: clear, cold, and dry. 26. Hazy: rain and sleet. 27. Very fine. 28. Cloudy: hazy: cloudy. 29. Sharp frost: clear: frosty. 30. Sharp frost: clear: fine.

Mean temperature of the month 39°·30

Mean temperature of Nov. 1855 40°·91

Mean temperature of Nov. for the last thirty years 42°·93

Average amount of rain in Nov. 2·313 inches.

Boston.—Nov. 1. Cloudy: rain A.M. 2, 3. Cloudy. 4. Foggy. 5. Cloudy. 6, 7. Fine. 8. Cloudy: rain A.M. and P.M. 9, 10. Fine. 11. Cloudy: rain P.M. 12. Cloudy: rain A.M. and P.M. 13. Cloudy. 14—16. Fine. 17. Cloudy. 18. Fine: rain A.M. 19. Cloudy: rain A.M. 20. Fine. 21. Cloudy. 22. Fine: rain A.M. 23. Cloudy. 24. Fine: rain P.M. 25. Fine. 26. Fine: snow A.M. 27. Cloudy. 28, 29. Fine. 30. Fine: snow P.M.

Sandwich Manse, Orkney.—Nov. 1. Clear, fine A.M.: cloudy, fine P.M. 2. Showers A.M. and P.M. 3. Bright A.M.: cloudy P.M. 4. Cloudy A.M.: clear, fine, aurora P.M. 5. Fog A.M.: cloudy P.M. 6. Hazy, fine A.M.: clear, fine P.M. 7. Hazy, fine A.M.: fine, drops P.M. 8. Showers A.M.: cloudy, drops P.M. 9. Showers A.M.: sleet-showers P.M. 10. Snow-showers A.M.: sleet-showers P.M. 11. Snow-showers A.M.: hail-showers P.M. 12. Cloudy A.M.: clear P.M. 13. Showers A.M.: hail-showers P.M. 14. Snow-showers A.M.: hail-showers P.M. 15. Showers A.M.: snow-showers P.M. 16. Cloudy A.M.: drizzle P.M. 17. Showers A.M. and P.M. 18. Cloudy A.M.: showers P.M. 19. Showers A.M.: cloudy P.M. 20. Cloudy A.M.: drizzle P.M. 21. Drizzle A.M.: rain P.M. 22. Rain A.M.: drizzle P.M. 23. Damp A.M.: drizzle P.M. 24. Drops A.M.: hail-showers, drift P.M. 25. Snow-showers A.M.: cloudy P.M. 26. Cloudy A.M.: rain P.M. 27. Showers A.M.: snow-showers P.M. 28. Hail-showers A.M. and P.M. 29. Hail-showers A.M.: hail-showers, drift P.M. 30. Bright A.M.: hail-showers P.M.

Mean temperature of Nov. for previous twenty-nine years ... 42°·67

Mean temperature of this month 40°·22

Mean temperature of Nov. 1855 43°·49

Average quantity of rain in Nov. for previous sixteen years ... 4·11 inches.

The mean temperature of the room in which the barometer is kept was 59°, and the height above the sea-level is 100 feet, so that the observations can be reduced to 32° and sea-level if required.

*Meteorological Observations made by Mr. Thompson at the Garden of the Horticultural Society at CHISWICK, near London ;
by Mr. Veall, at BOSTON ; and by the Rev. C. Clouston, at Sandwick Manse, ORKNEY.*

Days of Month.		Chiswick.		Barometer.		Thermometer.				Wind.		Rain.	
				Orkney, Sandwick.		Chiswick.		Boston.		Orkney, Sandwick.			

THE ANNALS

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IX.—*On the Organization of the Infusoria, especially the Vorticellæ.* By Dr. C. F. J. LACHMANN*.

[With a Plate.]

IN the summer of 1852, when I had the pleasure of working in the laboratory of Professor J. Müller, he called my attention and that of another of his pupils, M. A. Schneider, to Stein's memoirs upon the Infusoria†.

These memoirs, in conjunction with the older and contemporaneous ones of Focke‡ and Cohn§, appeared to commence a new æra in the theory of the Infusoria; by their means we first obtained information regarding their propagation, of which, up to that time, we knew nothing, except fission and gemmation. Important and interesting as were the facts discovered by the three observers above mentioned, they still only formed the imperfect commencement of a history of the development of the Infusoria, to the further advancement of which many must contribute. Stein's observations appeared to be far from sufficient to show his supposition of the connexion between the *Vorticella* and *Acinetæ* as anything more than a rather vague hypothesis. For this reason we endeavoured to test their correctness by our own observations, and if possible either to fill up the deficiencies in Stein's series of observations, or to prove his supposition to be false.

* Translated from Müller's Archiv, 1856, p. 340, by W. S. Dallas, F.L.S.

† Untersuchungen über die Entwicklung der Infusorien; Wiegmann's Archiv, 1840, p. 91. Neue Beiträge zur Kenntniss der Entwicklungsgeschichte und des feineren Baues der Infusorien; Siebold und Kölliker's Zeitschrift, iii. p. 475. (Translated, Annals, new series, vol. ix. p. 471.)

‡ Amtlicher Bericht der Naturforscherversammlung zu Bremen, 1844, p. 110.

§ Siebold und Kölliker's Zeitschrift, iii. p. 277.
Ann. & Mag. N. Hist. Ser. 2. Vol. xix.

We soon succeeded in getting Stein's *Acineta* of the Duckweed*, which he regards as the resting-form of *Vorticella nebulifera*. A. Schneider first found a specimen with an embryo already rotating, the escape of which we then expected with impatience; but this, like all the other specimens whose birth we observed during the summer, escaped from our sight before becoming attached and converted into an *Acineta* or a *Vorticella*.

Once, however, Professor Müller, whilst searching for an *Acineta*-bud which had escaped from him, found an animal which was exactly like it, swam very slowly, and at last, becoming perfectly stationary, gave forth rays and grew into an *Acineta*.

This observation of course increased our doubts as to the correctness of Stein's view. It is true we were not certain whether the animal which became an *Acineta* was truly an *Acineta*-bud, which, according to Stein's representations, ought to have become a *Vorticella*, or whether it was not perhaps a *Vorticella* already metamorphosed, which had then become converted into an *Acineta*, certainly in a very different manner from that supposed by Stein. In any case, this fact could not but urge us to trace the subject further.

In the course of that summer no decisive observation was made. But when I afterwards continued these observations in Brunswick, Würzburg, Göttingen, and Berlin, and paid a close attention to the organization of the families of Infusoria in question, and also to that of other families, I arrived at the conviction that Stein's view of the conversion of the *Vorticella* into *Acineta* was erroneous: that his description of the *Vorticella*, although far better than that of his predecessors, was still very defective: and that all Infusoria are neither polygastric, as Ehrenberg states, nor composed of formless substance, as asserted by Dujardin; but that, as already stated by Meyen†, they are animals with a large digestive cavity,—which, however, must not be regarded, as he thought, as the interior of a cell, but the part which Meyen and most of the recent authors regard as the cell-membrane must be looked upon as the parenchyma of the body,—which does not represent the membrane of a cell any more than that of the Polypes,—a view which has been taught for years by Professor J. Müller in his Lectures on Comparative Anatomy. In the hope that perhaps they may possess some interest, I venture to communicate the principal results of my investigations of the Infusoria. I may therefore be permitted to describe the digestive apparatus of the *Vorticella* somewhat in detail, and to compare it with that of the other

* Die Infusionsthierchen auf ihre Entwicklungsgeschichte untersucht, 1854, p. 59.

† Müller's Archiv, 1839, p. 74.

Infusoria, so as by this means, as also by reference to the other systems of organs to be observed in the Infusoria, to support my opinion previously expressed regarding the structure of these animals; and in the exposition of the portions of the developmental history of the Infusoria at present known, to refute the above-mentioned opinion of Stein.

Although the *Vorticellæ* were amongst the first Infusoria discovered by Leenwenhoek in 1675*, and from their attachment by means of a stem, appear to be for the most part more accessible to observation than many of the other free-swimming Infusoria, yet their external coarser structure remained very imperfectly known up to the time of Ehrenberg, as is proved at once by the great changes of place (*Irrfahrten*) in the systems of zoologists which had to be made, especially by certain developmental forms of them, which are so admirably brought together by Ehrenberg in his great work on the Infusoria†.

Before the time of Ehrenberg, authors regarded the *Vorticellæ* as animals of somewhat the form of a hollow hemisphere or bell fastened by its convex part to a stalk. In front of the supposed opening of the hollow bell (Ehrenberg first showed that this was closed, and that there was only a small opening on the side of the surface closing the orifice of the bell (*Stirn*) leading into its interior), a vortex was seen to be produced, which drew all small particles suspended in the water to the bell; but nevertheless none of the authors could persuade themselves into the belief that in this case small particles were actually taken up or caten, even O. F. Müller asserting‡, “In omnibus meis observationibus ne minimum animalculum vel moleculam unquam devorari—vidi. Pelliculas vegetabiles tangere et quasi rodere amant (*Vorticellæ*); aquam vero nutritione eorum sufficere facile persuadeor.” With regard to the mode in which this vortex was produced, of course the opinions were for a long time by no means satisfactory. In many, the cilia producing this movement were not yet found, so that Wrisberg§, and even Agardh|| and Wiegmann¶, explained the attraction of the smaller Infusoria towards the bell of the *Vorticella* by a power of fascination like the celebrated one of the Rattlesnake; and Bory de Saint Vincent constituted a peculiar genus (*Convallarina*) for these aciliated *Vorticellæ***.

In others, some, but not all, of the cilia surrounding the anterior opening were detected;

* Philosophical Transactions, 1676.

† Die Infusionsthierehen, pp. 275 and 286.

‡ Animalcula Infusoria, p. xii.

§ Observat. Infus. p. 63.

|| Verhandlungen der K. Leop. Akad. ii. 1. p. 135.

¶ Ibid. iii. 2. p. 557.

** Dictionnaire Classique, iv. p. 412.

but as the magnifying powers employed were not sufficiently strong and defined to show the individual cilia, one or two small constantly moving horns (*Hörnchen*, Leeuwenhoek) or whip-lashes (*Vipperspitzten*, Rösel*) only were discovered on each side of the orifice of the bell seen in profile, where several moving cilia came behind each other, and thus caused a strong shadow. In some the number of cilia seen increased, so that at last, in many, an entire circle of cilia surrounding the margin of the bell was discovered.

Besides these parts belonging to the nutritive apparatus, two other organs were seen in some *Vorticellæ* (by Rösel† in *Epistylis flavicans*, Ehrbg.),—the band-like body indicated by Ehrenberg as the testicle, and by Von Siebold‡ as the “nucleus,” and the contractile space characterized as a seminal vesicle by Ehrenberg; the latter, however, was observed only as a clear round spot, without any perception of its periodical disappearance. The globular masses of swallowed and aggregated particles in the interior of the body were regarded as swallowed monads or “vesiculæ interancæ,” or as ova. Gleichen§ was not even led to the right conclusion by his feeding the animals with colour, but preferred regarding the red masses of excrement coloured by the administration of carmine, not as what they were, but as eggs, to which he then attributed a particular attraction for carmine||. [He gave the Infusoria carmine as food, with the view of perhaps seeing the internal parts coloured thereby, as the bones of Pigeons fed with madder become red, but not to ascertain the form of the digestive apparatus by the deposition of a readily recognizable substance, such as the coloured particles, in its interior. Ehrenberg was the first to employ feeding with colour for the latter purpose.]

In the stem, even of the species in which this is contractile, no differentiation of parts was yet known. Gleichen¶ probably only saw the inner (muscular) filament, and regarded the particular parts of it, which he detected during contraction, as eggs, which were laid through the ovipositor (the stem).

For the *Vorticellæ*, as for most Infusoria, Ehrenberg** gave the clue to the recognition of their organization by his discovery of

* Insektenbelustigungen, iii. p. 602.

† *Ibid.* iii. p. 614. tab. C.

‡ Vergleichende Anatomie.

§ Abhandlung über die Samen- und Infusionsthierchen, p. 140.

|| A similar explanation is given by Laurent, whose fancy, working in a particular direction, easily overcame his slight power of observation. See his *Etudes physiologiques sur les Animaux des Infusions végétaux, comparés aux Organes élémentaires des Végétaux*; Nancy, 1854,—a book filled with the most astonishing errors.

¶ *Loc. cit.* p. 153.

** Abhandl. der Berl. Akad. 1830-31, and *Die Infusionsthierchen*, 1838.

the true commencement and termination of their digestive apparatus. [With regard to his opinion of its intermediate portions we shall have to speak further hereafter.] In showing that the supposed open mouth of the bell-shaped body of *Vorticella* is closed by a disk (*Stirn*) set with a circlet of cilia, at the edge of which there is a pit containing the mouth and anus, he only overlooked the projecting seam, which is often even turned backwards, which surrounds the disk (*Stirn*) outside the cilia and the pit, and is indicated even by Röscl and O. F. Müller. To this seam Stein* now again calls attention†; he calls it the "peristome‡," and shows that it is separated by a furrow from the disk bearing the cilia, so that this only forms the upper surface of a "bonnet-shaped" process projecting within the peristome, which he calls the "rotatory organ" (*Wirbelorgan*); on this he distinguishes the upper surface bordered by the circlet of cilia as the "disk" (*Scheibe*), and the lateral walls as the "stem" (*Stiel*) of the rotatory organ. The *Vorticellæ* can retract the rotatory organ deeply into the body, and then form a cap-like cover over it by the sphincter-like contraction of the peristome.

Whilst Ehrenberg, in accordance with the idea which he had of the structure of his *Polygastrica*, supposed he saw an intestinal canal proceeding from the mouth, to the sides of which vesicular stomachs were attached, and which, being bent into a loop, led back again to the lateral pit on the margin of the bell; the alimentary tube, according to Stein, is only an inversion of the external membrane, which hangs down into the soft parenchyma of the body in the form of a short tube, truncated below. The balls of food formed at the end of the œsophagus penetrate through the parenchyma of the body in curves, sometimes describing more than one circuit, and are again thrown out backwards through the œsophagus: in *Opercularia berberina*, Stein§ (*Epistylis berberiformis*, Ehrbg.) alone, he saw the balls of excrement pass through the lower wall of the throat (*Rachen*), as he calls the commencement of the œsophagus in the *Opercularia*, in which it is wider than in most other *Vorticellinae*, and not through the œsophagus, and then thrown out.

* *Loc. cit. supra*, especially in *Die Infusionsthierchen auf ihre Entwicklungsgeschichte untersucht*, 1854, p. 8.

† The descriptions and figures of the *Vorticellæ* by Dujardin and Perty are very inexact; but yet Dujardin's figures indicate the relations of the parts correctly, although, like all his figures of Infusoria, they are very indistinctly and carelessly executed.

‡ In the figures it is indicated by *a a*.

§ *Die Infusionsthierchen auf ihre Entwicklungsgeschichte untersucht*, 1854, p. 101. Of Stein's works I shall only quote this book, which is so rich in interesting observations.

If we consider a little more closely the nature of the circlet of cilia which bears their food to the *Vorticellæ*, we find* that it does not form a complete circle, but a spiral line†. This begins in the vicinity of the orifice called the mouth by Stein (Pl. IX. figs. 1-3 *c, d*) a little to the right of it upon the ciliary disk (fig. 1-5 *b*), runs above this orifice towards the left and round the margin of the ciliary disk; but before it again reaches its starting-point, it descends upon the stem of the rotatory organ into the commencement of the digestive apparatus.

This commencement of the digestive apparatus (fig. 1 *c, d, e*; fig. 2 *c, e*; fig. 3 *c, d, e, f*, and fig. 4 *c, e, f*) cannot yet be regarded as the throat, or as a part of the œsophagus (as Stein has done), for the anus opens into it (at *e*); we will therefore, by the recommendation of Professor J. Müller, distinguish it by the name of *vestibulum* from the other parts of the alimentary apparatus. Ehrenberg figures this part too shallow, as a lateral pit in which the mouth and anus are placed; whilst Stein only distinguishes it from the true œsophagus in the *Operculariæ*, in which it is rendered remarkable by its width, but in most of the *Vorticellinæ* regards it as the commencement of the œsophagus.

The vestibulum continues the spiral line formed by the row of cilia, constituting a bent tube, which contains a portion of this spire of cilia. In accordance with the direction of this spiral, the concavity of the tube is turned towards the right and its convexity towards the left: on the convex side the lumen of the tube is still more enlarged, especially in the parts placed furthest inwards where the anus opens (at *e*). Between the anus and the mouth which leads further inwards into the œsophagus (figs. 3 & 4 *e, f*) springs a bent bristle (figs. 1-5 *e, g*), which is generally long enough to project outwards beyond the peristome. This bristle is stiff, and is only displaced a little to one side occasionally, when balls of excrement which are too thick to pass between it and the wall of the vestibulum are thrown out from the anus, but it immediately returns again to its old position.

From the mouth a short tube, the *œsophagus* (figs. 3 & 4 *e, f, h*; fig. 5 *h*), with a far smaller lumen than the vestibulum, leads to a rather wider fusiform portion (figs. 4 & 5 *h, i*), which we will call the *pharynx*. In most *Vorticellinæ* (those with a con-

* To facilitate the subsequent description, we must distinguish a dorsal and ventral surface and an anterior and posterior part in the bodies of the *Vorticellæ*: we follow in this the mode of indication of Ehrenberg, denominating the attached part of the body the posterior, and the disk or rotatory apparatus the anterior, and characterizing that side of the bell which is nearest to the mouth as the ventral side.

† Ehrenberg represents this line as a spiral in some *Vorticellæ*, but generally reversed, whilst Stein describes it as a circle.

tractile stem, and the species of *Epistylis* and *Trichodina**) the longitudinal axis of the vestibulum and œsophagus runs tolerably parallel to the plane of the ciliary disk, whilst that of the pharynx has rather the direction of the axis of the body. In these, therefore, the axis of the ciliary spiral, which is continued as far as the pharynx, changes its direction at the commencement of the vestibulum: whilst it coincided with the axis of the body outside the vestibulum, it stands almost perpendicular to it within the vestibulum and in the œsophagus. In the very elongated forms of the *Ophrydinæ*, Ehrbg., which inhabit sheaths (*Ophrydium*, *Vaginicola*, *Cothurnia*†), the longitudinal axis of the vestibulum and œsophagus coincides more with that of the body, as also in the genus *Opercularia* (as circumscribed by Stein) and *Lagenophrys*, Stein; in the two latter the vestibulum is very wide, whilst in the elongated species it is narrow, but generally possesses a deep excavation for the anus.

The portion of the ciliary spiral which is situated outside the vestibulum is not of equal length in all *Vorticellinæ*: in many (*Vorticella*, *Carchesium*, *Zoothamnium*, *Scyphidia*, *Trichodina*‡,

* *Trichodina pediculus*, Ehrbg. and *T. mitra*, Siebold. The other species of Ehrenberg's genus—*Trichodina grandinella* (*Halteria grandinella*, Duj.), *tentaculata* and *vorax*,—are not *Vorticellinæ*, and this is also the case with *Urocentrum*. On the other hand, Dujardin's genus *Scyphidia* approaches this group of the *Vorticellinæ*; it was founded by him for the sessile, stemless forms, without a carapace. It is true that all the species described by him and Perty as belonging to this genus are to be removed from it, as they have a short stem, and only appear to be particular states of pedunculate *Vorticellinæ*, in which the stem has not attained its usual length; but on the other hand two other species must be included in it, both of which attach themselves to the naked parts of small freshwater Mollusca, and never form a stem, but which were often observed by me in process of division, and are easily distinguished from other forms, which are also attached at first, by their posteriorly-truncated form and a projecting pad at the margin of the hinder end. The *Sc. limacina* (*Vorticella limacina*, O. F. Müller) lives on small species of *Planorbis*. The body is nearly cylindrical, tapering a little at each end, and annulated; the peristome is narrow and not turned backwards; the ciliary disk is narrow and furnished with a projecting umbilicus in the middle, and the posterior truncated surface is provided with a thick pad-like margin. Length of the animal $\frac{1}{10}$ – $\frac{1}{8}$ mm. The second species, *Sc. physarum*, Lachmann, lives on the naked parts of species of *Physa*. It is longer and more uniformly cylindrical than the preceding; the peristome is longer and often turned backwards, and the hinder margin is thinner and shorter.

† The genus *Tintinnus*, of which, in company with M. E. Claparède, I observed many species on the Norwegian coast, is ciliated all round, and differs so greatly in the alimentary apparatus from the *Vorticellinæ*, that it is impossible for it to remain in the same family. A species inhabiting a gelatinous sheath occurs also in the fresh water in the Thiergarten at Berlin.

‡ The most recent describer of *Tr. pediculus* mentions the existence of a ciliary spiral leading to the mouth: Stein regarded this as a circle.—Müller's Archiv, 1855, p. 357.

some species of *Epistylis*, &c.) it scarcely describes more than one circuit round the disk, whilst in *Opercularia articulata* and *Epistylis flavicans* it runs round the disk three times*, and in others the length lies between these two extremes. This portion consists of a double row of cilia; those of the outer row are usually somewhat shorter than those of the inner, and inserted upon the ciliary disk nearly in the same line, but at a different angle, as they appear to be far more strongly bent outwards†: in the vestibulum and œsophagus the cilia appear to stand in a single row. The peristome bears no cilia: those represented upon it by Stein belong to the outer series of cilia of the disk, or to that portion of the spiral which descends on the stem of the rotatory organ into the vestibulum. The latter also, perhaps in conjunction with the bristle above mentioned, appear to have been what induced Ehrenberg to suppose the existence of a frilled lower lip in *Epistylis nutans*, and Stein in all the *Opercularia*.

To see the particulars above described, it is peculiarly advantageous to observe animals which have died during expansion; the outline of one of these is shown in Pl. IX. fig. 2.

By the vortex produced in the water by the cilia of the spiral, the small particles swimming in the vicinity are attracted and at last reach the vestibulum; a portion of them is constantly thrown out again, and another portion is whirled down into the pharynx through the œsophagus. Besides the cilia of the spiral, some stronger cilia (e and f) also stand in the vestibulum in front of the mouth; these do not take part in the regular activity of the others, but only strike forcibly sometimes, apparently to remove from the vestibulum coarse substances which may have got into it, and also the masses of excrement. [These are also figured by Stein in all *Vorticellinae*.] In the fusiform pharynx (h, i) the nutritive matters are aggregated into one morsel, which, when it has attained a certain size, is passed into the interior of the body‡. Meyen§ calls this fusiform part a stomach, in which I cannot agree with him, as it evidently serves only for the aggregation of the food into morsels, and the digestion only takes place further in the interior of the body; I have therefore preferred for it the

* For this reason Stein describes three circles of cilia on the disk of the former.

† In the Plate the cilia of the outer series are only indicated at the margin of the figures, but omitted in the remainder of the ciliary spiral in order to prevent the figures from appearing too complicated.

‡ Pouchet (*Comptes Rendus*, Jan. 15, 1849) speaks of a respiratory organ in the *Vorticella*, which, from his description, can only be the pharynx. The value of his statements regarding the polygastric structure of the Infusoria is sufficiently clear from this, as he considers the commencement of the digestive apparatus as not belonging thereto.

§ Müller's *Archiv*, 1839, p. 75.

name of pharynx, which is open to but little objection. This pharynx is not merely a vacuity in the surrounding gelatinous substance, only produced by the water whirled into it, but it has proper walls which preserve its fusiform shape, even when no food is contained in it.

The morsel passed from the pharynx into the interior of the body runs nearly to the posterior extremity of the *Vorticella*, and then turning upwards (fig. 4 *l*) rises on the side of the body opposite to the pharynx. During this portion of its course, it usually still retains the spindle-shape communicated to it by the pharynx, and only here changes to the globular form, often rather suddenly: this induced me at first to think that the morsel was still enclosed in a tube during this part of its course, and this opinion seemed to be supported by the circumstance that before and behind the morsel, two lines are not unfrequently seen (fig. 4 *l*), which unite at a short distance from it, like the outlines of a tube which it has dilated. Subsequent observations, however, have again shown me that this opinion is an improbable one, for the circumstances described must also occur, when a fusiform morsel is passed with some force and rapidity through a quiescent or slow-moving tenacious fluid mass: the above-mentioned lines, before and behind the morsel, must be produced by the separation and reunion of the gelatinous mass, even if the morsel is not surrounded by a tube. But the existence of a tube depending from the pharynx appears also to be directly contradicted by the fact, that on the one hand the curves described by the morsel are sometimes larger and sometimes smaller, and on the other that the morsel acquires the globular form sometimes sooner and sometimes later, according as it is pushed out of the pharynx with greater or less force and rapidity. The masses whirled into the pharynx are not always aggregated into a morsel, but sometimes, under conditions which have not yet been satisfactorily ascertained, all the masses which reach the pharynx are seen to pass quickly through it without staying in it; they then stream through the mass surrounding them in a clear streak, which, like the morsels, describes a curve at the bottom of the bell, and only mix with the mass when their rapidity of motion has diminished*. We might easily be inclined to regard the clear, bent streak with the particles flowing in it, as an intestine; and this has probably been done by Ehrenberg, who states that he distinctly saw the bent intestine in some *Vorticellinae*, especially in *Epistylis plicatilis*, in which I have also been able to study the phenomenon very closely. But in this case,

* A roundish morsel, which might be regarded as a full stomach, is then never formed.

also, there are the same reasons against the supposition of an intestinal tube, as in that of the lines appearing before and behind a fusiform mass: here likewise, not only the form, but also the length of the curve varies: whilst at one time it is but short, and soon terminates by the intermixture of the particles contained in it with the surrounding mass, it may immediately afterwards be twice as long or longer*, a variation which appears only to depend upon the force with which the cilia of the rotatory organ act; so that we cannot explain the whole phenomenon otherwise than that the water with the particles contained in it streaming with some rapidity into the mass with which the body is filled, cannot mix with the latter immediately, but only when its rapidity of motion is diminished by friction; just as we see a rapid stream which falls into a sluggish or stagnant pool, or into the sea, still retaining its independence for a certain space, so that if it differs in its colour or turbidity from the water of the sea or pool, we may distinguish it from the latter, with which it does not mix for a long time, in the form of a streak, which is often of great length.

When the nutritive particles in the body of the *Vorticella* have attained the end of the clear streak under a constant diminution of their rapidity, and in the other case, when the morsel has lost its spindle-shape and become globular, they have no longer any separate movement, but now only take part in a circulatory motion, in which all the parts in the interior of the body, with the exception of the band-like organ (testicle, according to Ehrenberg; nucleus of Von Siebold and most recent authors†), are engaged. This circulation is usually slow (slower than in the green *Paramecium Bursaria*, Focke), and therefore generally overlooked; it rarely ceases for a time entirely. The morsel of food performs sometimes more, sometimes fewer circuits with the rotating mass, until at last it arrives in the vicinity of the anus (e), when its circulation ceases, and the anus opens and allows the mass to escape into the vestibulum (fig. 3 e).

From this description of the processes of nutrition in the *Vorticellinae*, it may be seen at once that it is impossible to attribute to them an intestine with many adherent vesicular stomachs, as Ehrenberg supposes. The existence of the circulation of the entire contents of the body contradicts this supposition. Ehrenberg himself soon saw the insufficiency of the first explanation

* It may even make a complete circuit and return nearly to its point of commencement beneath the pharynx.

† As we shall hereafter see that the signification of this organ cannot yet be established with certainty, we shall provisionally retain the name of nucleus, but without wishing to attach thereto the idea of a cell-nucleus.

which he attempted of the movement of the internal parts of the body*, which had then been seen only in a few species of Infusoria by Focke†, namely, referring them to a displacement of the parenchyma of the body, and perceived that the actual circulations compel the admission of a large cavity, in which the circulating masses are contained. Ehrenberg, however, supposed‡ that this condition of the animals was not to be considered as the normal one, as Meyen had done§, and regarded it only as a transitory pathological state produced by the enlargement of one stomach at the expense of the others. In this case, therefore, the contents of all the previous stomachs would be poured into one; every portion previously contained in a stomach might consequently have retained the globular form, which it had acquired in consequence of the shape of the stomach. This supposition appeared to explain the phenomena so long as the rotation could be considered only as a transitory state occurring in particular species||; but if it were correct, the new masses taken in during the rotation could no longer assume the globular form, but must simply mix with the contents of the large stomach. But we see that the formation of the globular morsels takes place even when the rotation of the masses contained in the large cavity of the body is very lively, and we also find that in most Infusoria¶ the state of rotation is the ordinary one, and that the quiescent state of the internal masses is only transitory, so that we are compelled to regard the state in which the body includes a large digestive cavity, as the normal condition.

In opposition to Ehrenberg's views, Dujardin, as is well known, developed his theory of sarcode and vacuoles**, according to which the whole body of the Infusoria only consists of formless, moveable animal substance, into which the food is pressed or whirled by cilia, and in which cavities (*vacuoles*) may be formed in any place, filled with a transparent fluid, which, like the entire mass of which the animal is composed, is denominated *sarcode* by Dujardin. This opinion now finds but little accept-

* Die Infusionsthierehen, p. 262. † Müller's Archiv, 1839, p. 81.

‡ Isis, 1836, p. 786.

§ Ibid. p. 74.

|| Ehrenberg was the more fixed in this conviction, as he really believed he had directly seen the branched intestine which he ascribed to all his Enterodolous Polygastrica in *Trachelius Ovum*; we shall have occasion to speak of it further on.

¶ In all which possess an open ciliated oesophagus. (See further on.)

** Histoire naturelle des Infusoires. This theory may be regarded as a carrying out of the idea which found the greatest number of adherents in the preceding and the commencement of the present century up to the time of Ehrenberg: according to this, the Infusoria were only vivified mucus.

ance* in its original meaning, and we may refer to it in common with the modification which it has undergone in Germany, as in both we have to combat the opinion that the mass rotating in the interior of the body of the Infusoria is to be regarded as a part of the parenchyma of the body, whilst we may rather consider it, with Ehrenberg, as chyme, or the contents of a digestive cavity.

The principal modification which was effected in Dujardin's opinion, in Germany, is, as is well known, the further development of the analogy of an Infusorium with an animal or vegetable cell pointed out by Meyen in 1839, and which has been especially adopted by Von Siebold† and Kölliker‡. According to them, the whole body of an Infusorium consists of a cell-membrane and its tenacious fluid contents, both of which are contractile (the contractile space, or the "seminal vesicle" of Ehrenberg, was then only a contractile part of the cell-contents): the cell-nucleus was seen in the body regarded by Ehrenberg as the testicle, and the nucleolus of the cell was found in a corpuscle not unfrequently placed in the nucleus, but in many cases (curiously enough for the cell-theory) lying close to it. No hesitation was caused by the fact that the cell had an orifice, the mouth, from which a tube hung down as an œsophagus into its interior. The existence of an anal opening was generally denied, and it was supposed that the unserviceable matters were pushed out through any part of the cell-wall; at the utmost it was admitted that a particular portion of the cell-wall was to be regarded as the anal region, which was peculiarly adapted for this purpose.

If we may, *à priori*, regard the existence of unicellular animals

* Perty supports it in his book 'Zur Kenntniss kleinster Lebensformen' by the most superficial and inexact figures. During the past year Perty has published a letter, in which he attacks Ehrenberg in the most savage—one may even say unjustifiable manner, and entirely forgets the great services done by this naturalist to our knowledge of the Infusoria. Without noticing whether and how far his reproaches are just, the spirit in which they are made is certainly not to be tolerated, and Perty, of all men, has the least cause for making such statements, as by the slight alteration of a few names, a great part of his charges might be turned against himself with equal, if not greater propriety. I shall be excused if, as a proof of this, I here reprint one of Perty's strongest expressions with such alterations; the variations from Perty's original are shown by the insertion of his expressions in parentheses:—"Establishment of that ridiculous monster: Phytozoidia (Polygastria), in which the most incompatible things: Infusoria of a truly animal nature, creatures of doubtful position, and decided plants of various groups (Rhizopoda, Infusoria, Phytozoidia, decided plants of various groups) are thrown together into a monstrous whole."

† *Zeitschrift für wiss. Zoologie*, i. p. 270.

‡ *Ibid.* i. p. 200. The theory of the animal cell in Schleiden and Nägeli's *Zeitschrift für wissenschaftliche Botanik*, 1845, &c.

as possible, we can certainly not consider the Infusoria as such, at least not those which are most accessible to observation, namely, the larger forms, especially Ehrenberg's *Enterodela*; the smaller species, which are more difficult to observe, must then be judged by analogy, until we understand better how to observe them. Even if we do not hesitate on account of the remarkable position of the nucleolus outside the nucleus in many Infusoria, the presence of an oral aperture, or, as we shall hereafter show to be the case in the *Acinetinae*, of many mouths, of an œsophagus, and of a second orifice, the anus* (the existence of which we shall prove), there is still a great deal that can be urged against the cell-theory, for which we are particularly indebted to Cohn's observations.

Cohn showed† that in the Ciliata, besides the thin skin of the body which bears the cilia, or the cell-membrane according to previous views, two other strata are distinguishable in the body, —the inner rotating layer, and a quiescent "cortical layer‡," often of considerable thickness, surrounding this; he considers this cortical layer as the cell-membrane, which is enveloped externally by a ciliated cuticula, and only regards the internal, frequently rotating layer as the cell-contents.

The cuticle, which in plants is generally regarded as a hardened cell-secretion, is then said, in those Infusoria which are ciliated all round, to bear small, four-sided prisms, at the apex of each of which there is a cilium; these are generally arranged in spiral series, crossing each other§. The supposed cell-membrane or cortical layer encloses the contractile vesicle and a system of vessels proceeding from this (see further on); it also frequently contains chlorophyll-globules, or colourless globules of the same form, which were regarded as eggs by Ehrenberg, but as to the signification of which we have as yet no observations. In many Infusoria, especially the *Ophryoglena* (in which it lasts long after the decomposition of the animal) and (less persistent) in many species of *Paramecium* (*P. Bursaria*,

* The idea of the cell would certainly by this means be remarkably modified, and by its too great extension would lose all signification.

† Siebold und Kölliker's Zeitschrift, iii. p. 257, v. p. 420.

‡ These are very well seen in Infusoria treated with chromic acid.

§ In *Stentor polymorphus* (to which *S. Mülleri* and *Roeselii* are also to be referred) single long hairs stand between these, similar to the hairs of many *Turbellaria* (fig. 9); this is also the case in a species of Infusorium allied to the *Stentors*, which will be hereafter described. The foot-like hooks (*uncini*) and styles (*styli*) articulated to the body, occurring in the *Ocyrtichinae* and *Euplotes* (and the *Aspidiscinae* of Ehrenberg) are well known: a portion of the former, those which are trailed along, are split up at the apex into as many as eight parts in various *Euplotes* (for instance, *E. patella*); one of the styles in *E. patella* bears a number of small lateral branches.

Focke, *P. Aurelia*, *P. caudatum*, and *Bursaria leucas**), there are fusiform rods in the cortical layer, from which Allman states he has seen urticating filaments projected†. In the *Vorticella* we shall hereafter have to describe in the cortical layer a contractile layer as the continuation of the muscle of the stem. We cannot certainly regard a part so complicated as the membrane of a cell; I believe that this "cortical layer" (of Cohn) is rather to be considered as the parenchyma of the body of the Infusoria, whilst the rotating mass only constitutes the contents of a large digestive cavity or stomach, and therefore must be regarded as chyme, and that Cohn's "cuticula" forms the true skin of the Infusoria.

The "cortical layer" alone is contractile: in torn Infusoria fragments of it not unfrequently contract, whilst the internal mass, the chyme, which flows out, never does this. When an Infusorium is sucked out by an *Acineta*, the cortical layer or parenchyma of the body may often contract for a long time, and the contractile vesicle placed in it may also continue its contractions for hours; nay, I have observed a *Stylonychia*, which, although a considerable part of its chyme had been sucked out of it by an *Acineta*, still underwent division, so that one of the gemmules of division swam away from it briskly, and only the other half of the old animal was destroyed. This appears also to a certain extent to prove that the mass sucked out does not represent the true parenchyma of the body, and as it only fills the large cavity of the body in the form of a tenacious fluid mass, and becomes mixed with the nutritive matters, especially when no small masses are formed, it is certainly the most natural course to regard it as chyme. It cannot be urged against this view, that in those Infusoria which contain chlorophyll-corpuscles in the substance of their bodies, we sometimes meet with single corpuscles in the rotating mass, as they may certainly be easily loosened from the parenchyma, and thus get into the chyme-mass. The nucleus, indeed, projects into the chyme-mass; but as a general rule, it appears to be affixed to the parenchyma of the body, as we do not see it rotate with the chyme-mass‡: in *Opercularia berberina*, Stein sometimes saw

* See O. Schmidt, 1849, p. 5.

† Similar, but much thicker corpuscles, which presented a deceptive resemblance to the urticating organs of the *Campanulariæ*, were found by me and my friend, E. Claparède, in an animal living as a parasite upon *Campanulariæ*, which is probably to be referred to the *Acinestiæ*, and which we shall take another opportunity of describing. In the oval embryos, ciliated on one side, which were squeezed out of the body of the mother, we were enabled to convince ourselves that these corpuscles were enclosed from two to nine together in a roundish proper vesicle (cell?).

‡ When it divides, as is usually the case in the development of embryos

the nucleus moved a little out of its previous position by a mass of food striking against it; but as it soon returned again to its position, this rather speaks for than against its attachment. In different individuals of the same species, the nucleus does not always occupy the same situation,—a circumstance which may probably be explained by fission, as in the transverse division of an Infusorium, in which the simultaneously divided nucleus lies about in the middle, one portion of the nucleus will be situated in the posterior part of the anterior bud, whilst the other part will occupy the anterior part of the posterior one.

In many respects the parenchyma of the body of Infusoria resembles that of the Turbellaria, in others that of the Polypes; they also approach the latter especially by the possession of a large digestive cavity, in which, as in the *Actinæ*, a tube (œsophagus), open at the bottom, generally hangs down. Whether the wall of this digestive cavity or stomach be one and the same with the parenchyma of the body, or separate from this, cannot at present be decided in most cases, although the former appears to be the case: in *Trachelius Ovum* alone we see a proper stomach-wall separated from the rest of the parenchyma by spaces filled with fluid, and thus form an arborescent ramified canal, which however must not be confounded with the nucleus*.

The digestive cavity of the Infusoria (certainly at least that of the ciliated and some of the flagellated forms) possesses, besides the mouth, a second orifice, the anus. This is certainly denied by most of Ehrenberg's opponents, but a long and careful observation of an individual will always show that the fæces are invariably thrown out at the same part of the body, and in many Infusoria we may frequently recognise the anus in the form of a small pit, on the surface of the animal, even for a considerable time before and after an excretion; (this is often the case in *Paramecium Aurelia*, *P. Bursaria*, Focke, and *Stentor*). That the fæces are not forced through the parenchyma at any point on the surface of the body, is proved especially by the careful observation of

(see below), individual fragments of fission usually separate and rotate with the chyme. When Siebold says (in his Comparative Anatomy, p. 24) that he has often seen an Infusorium rotate round its nucleus, it is not improbable that he has taken a rotating embryo (which, indeed, was not known at that time) for the nucleus.

* That this structure, described by Ehrenberg and disputed by others, really exists, was affirmed to me by Dr. Lieberkühn before I had the opportunity of investigating it closely myself; when I subsequently obtained this abundantly, I was enabled to convince myself of the correctness of the statement. The animals devoured (*Trachelius Ovum* is one of the most voracious robbers) are always seen lying in the ramifications of the stomach, in the clear spaces between them, except in crushed animals. The clear round spaces in the parenchyma of the body are certainly no stomachs, but contractile spaces.

Spirostomum ambiguum, and some new animals which are to be united with the *Stentors* in one family. In the former, the anus is situated at the hinder end of the animal, and close in front of it is the very large contractile vesicle; when fully expanded this vesicle appears to be surrounded only by a thin membrane, but nevertheless we see balls of excrement, often several at the same time, on different sides of the vesicle, separating the laminæ of its apparently simple covering, and forming projections which are often nearly hemispherical both towards the vesicle and the outer surface of the body. If masses of excrement do usually penetrate through the parenchyma of the body, we should expect it to be the case here when the tension of this is so great; we should also expect to see the masses of excrement pass into the contractile space if it were not a vesicle, but only a space in the parenchyma without proper walls. Neither of these things occurs, however; the fecal masses are not deposited from the body until they have reached the anus at the hinder extremity of the body. A similar strong expansion of a thin part of the body by fecal masses, without any rupture, is seen, as already mentioned, in some new *Stentorinae*, which are distinguished from the genus *Stentor* by their having that part of the parenchyma of the body which bears the ciliary spiral and the anus (which in all the *Stentorinae* lies on the dorsal surface of the body close under the ciliary spiral (figs. 6, 7 & 8 e) and not in a common pit with the mouth) drawn out into a thin process. In one genus, of which I observed two species (one is the *Vorticella ampulla* of O. F. Müller) in company with E. Claparède on the Norwegian coast, and which I will describe elsewhere, this process is broad and foliaceous, and bears the rows of cilia on the margin, whilst the anus is placed far up on the dorsal surface of a thin plate. In the other genus, *Chatospira*, Lachmann (figs. 6 & 7), observed by me in fresh water near Berlin, the process is narrow and bacillar; the series of cilia commences at its free extremity, and only forms a spiral when in action by the rolling-up of the lamina; in this genus also the process bears the anus. In both, fecal masses (as at *m* in fig. 6) which are thicker than the process in its extension, pass through it to the anus (*e*), without breaking through it, notwithstanding the great expansion of its walls.

Not unfrequently, several balls of excrement unite into a large mass before the anus, in order to be passed out together. When an excretion takes place, the anus is seen to open (but often closes once more and opens again before the expulsion of the masses is effected), and then the fecal masses are often expelled slowly.

[To be continued.]

X.—New British Lichens.

By the Rev. W. A. LEIGHTON, B.A., F.B.S.E.

[With a Plate.]

Opegrapha anomala, Leight. Thallus thin, membranous, smooth, greyish cream-coloured, limited; lirellæ excessively prominent and sessile, large, linear-oblong, obtuse at the extremities, straight or wavy, simple, occasionally tripartite; disk rimæform, more or less expanded; proper margins tumid and connivent; sporidia in asci, eight, large, oblong or elliptical, margined, containing about nine horizontal rows of roundish yellow spores.

On holly, Glengariffe, co. Kerry, Ireland! *Mr. H. Piggot.*

Thallus a thin, membranous, scarcely subtartareous film, continuous, smooth and even, very slightly shining, of a pale greyish-creamy colour and aspect, forming an irregular patch of small extent, defined by a wavy watery brown line or margin. *Lirellæ* rather numerous, dispersed without regularity over the thallus, moderately large, though variable in size, stout and short, or linear-oblong, very prominent and sessile, of a clear raven-black and shining or even greasy-looking, either straight or slightly curved, and occasionally more or less wavy, simple or occasionally tripartitely branched, very thick and obtuse at the extremities, of about the same width throughout the entire length. *Proper margins* conspicuously swollen or rounded, and connivent, either plain, or not unfrequently, especially in the older lirellæ, marked with an irregular longitudinal interrupted furrow. *Disk* in the younger lirellæ a mere longitudinal conspicuous chink or furrow, becoming wider and deeper in an older stage. *Perithæcium* thick, carbonaceous, entire, surrounding the base and sides. *Paraphyses* rather distinct and easily to be distinguished, though conglutinated. *Asci* linear-oblong. *Sporidia* eight, large, oblong or elliptical, containing about nine horizontal rows of rather large subrotund yellow spores. Iodine turns the sporidia of a fuscate colour, slightly tinged with pale blue; on the paraphyses it has no effect.

The sporidia are similar to those of *Graphis scripta* (Leight. Brit. Graph. p. 27. tab. 6. fig. 17 *b*, and Leight. Lich. Brit. Exsic. 18! 19!) and *Graphis pulverulenta* (Leight. Brit. Graph. p. 31. tab. 6. fig. 18 *b*, and Leight. Lich. Brit. Exsic. 20!); but our plant differs from those lichens in the shape, relative situation, and structure of the lirellæ. It bears also at first sight some general external resemblance to *Aulacographa elegans* (Leight. Brit. Graph. p. 45; Leight. Lich. Brit. Exsic. 68!), but the crumpled lirellæ, with their accessory thallodal margin, and the

peculiar structure of the peritheccium and sporidia of that plant, at once separate them.

Dr. Nylander, in his "Nouv. Classif. des Lichens," mem. 2, in tome iii. Mém. Soc. Sc. Nat. Cherbourg, gives as chemical distinctions between the genera *Graphis* and *Opegrapha*, as arranged by him, the following: viz. *Graphis*: "sporæ iodo cæruleæ infuscatæ, eodem vero gelatinam hymeneam non colorante." *Opegrapha*: "sporæ iodo non tinctæ, gelatina vero hymenea ab eodem cæruleæ vel plerumque vinosæ-rubro colorata."

The present plant is in fact a true *Opegrapha* with an entire peritheccium, and not a *Graphis* with a dimidiate peritheccium; but as it partakes of Dr. Nylander's chemical character of *Graphis*, and has at the same time the sporidia similar to those of my *G. scripta*, I have named it on those accounts *Opegrapha anomala*.

We are indebted to the research of Mr. Horatio Piggot of Chelmsford, Essex, for this interesting addition to our flora.

PLATE VIII. fig. 1. *Opegrapha anomala*, nat. size. Fig. 2. Same, magnified. Fig. 3. Vertical section of apothecium. Fig. 4. Ascus and sporidia. Fig. 5. Sporidia, highly magnified. Fig. 6. Spermatia. Fig. 26. Scale of magnitude for figs. 5 & 6.

Coniocybe citrina, Leight. Thallus leproso-pulverulent, citrine; apothecia globose, yellowish-brown; stipes rusty-brown, pulverulent, short and stout; sporidia minute, linear-oblong, uniseptate, brown.

On the under surface of stones in the walls of the turnpike road between Corwen and Bala, North Wales, 4th June, 1856.

Thallus pulverulent, of a pale citrine colour, spreading indeterminately to a considerable extent, of greater or less thickness, either a mere sprinkling of dust, or else massed together in moderate thickness, and then broken up by cracks into irregular areolæ. Apothecia scattered, singly, or in groups of several together, stipitate. Stipes about $\frac{1}{4}$ of an inch or more high, nearly equal in thickness throughout, rusty-brown and pulverulent, bearing a small cup-shaped portion at the summit, which speedily becomes obliterated by the expansion on all sides of the round pulverulent mass of yellowish-brown sporidia, and the remains of the asci and paraphyses. I could not detect either asci or paraphyses, probably from the mature state of the apothecia. Sporidia minute, linear-oblong, uniseptate, pale brown. The septum is not always to be detected, and then the sporidia appear simple or entire; but I presume the septe condition is the normal one.

On the thallus occurred those minute plano-convex immarginate waxy-looking bodies which lichenists have been accustomed to regard as the apothecia of *Biatora lucida*, Fries (see Plate VIII. figs. 10 & 11). With all the careful manipulation in dissection

of which I am master, I have been unable to detect in these bodies either asci or sporidia, both of which however Massalongo describes and figures in his 'Ricerche Lich. Crost.' p. 126. fig. 249. To my eye, a thin vertical section showed a compact gelatinous mass, the outer surface of which was of a somewhat darker yellow, slightly striated (see Plate VIII. fig. 12), and this part became tinged blue with iodine, from which issued, by pressure in the compressorium of the microscope, a few minute linear-pyriform pale yellow bodies endowed with a slight Brownian motion (see Plate VIII. fig. 13). If then these convex masses be regarded as the apothecia of *Biatora lucida*, Fries, the thallus must belong to it, and *Coniocybe citrina* be only parasitical. But as I observed the *Coniocybe* continually recurring on the citrine thallus at intervals in considerable abundance during the whole stage from Corwen to Bala, a distance of 12 miles, I incline to regard the thallus as rather belonging to *Coniocybe citrina*, and the so-called apothecia of *Biatora lucida* as the spermogonia or receptacles of the supposed male organs of fructification.

From all other species of *Coniocybe* hitherto detected in Europe, *Coniocybe citrina* differs both in the sporidia and in other particulars. In *Coniocybe furfuracea*, Ach., and its varieties, as exhibited in Schær. Exs. 14! 296! 639!; Nyl. Lich. Paris. 7!; Leight. Lich. Brit. Exs. 225!; Heppé, Lich. Europ. 154!; and in my own herbarium from Upsal, Sweden! from Fries fil., and various parts of Britain!, the sporidia are minute, round and yellow (see Plate VIII. fig. 14). In *Coniocybe gracilentæ*, Ach., as in Von Zwackh, Lich. Germ. 21!; Heppé, Lich. Europ. 45!; and "in sylva Gurten, Schær."! from Dr. Guthnick of Berne, they are similar to those of *C. furfuracea*, Ach. (see Plate VIII. fig. 15). In *C. pallida*, Fries, as in Schær. Exs. 7! and from Upsal! Fries fil.; and in its varieties, *leucocephala*, Zwackh, 101 a! 101 b!, and Heppé, 155!; and *xanthocephala*, Zwackh, 102! Heppé, 44! and "circa Bernam, Schær." from Dr. Guthnick, the sporidia were much larger, round, with a pale hyaline margin and darker yellow central nucleus (see Plate VIII. fig. 16). *C. farinacea*, Chev., as in Nyl. Lich. Paris. 6!, has sporidia similar to *C. pallida*, Fries (see Plate VIII. fig. 16). In *C. hyalinella*, Nyl., as in Moug. & Nestl. 1162!, they were minute and pale yellow as in *C. furfuracea*, Ach., but larger in size (see Plate VIII. fig. 17). To *C. nigricans*, Fries, whether regarded as a distinct species, or according to Nyl. Nouv. Classif. "vix distinguenda a *C. subtili*, Pers.," as exhibited in Schær. Exs. 250! Zwackh, 14! and Heppé, 157!, our plant assimilated in the oblong pale-brown uniseptate sporidia (see Plate VIII. fig. 18), but differed in other respects; *C. nigricans*, Fries, having a white thallus, the apothecia black, and the stipes much stouter, black, perfectly smooth

and shining. It should be remarked, that De Notaris (Giorn. Bot. Ital. an. 2. 1. 316) says of *C. nigricans*, Fries, "sporidii elliptici," and Fresenius (in Bayrhofer Uebersicht, p. 93), "Sporen einfach, zuweilen in der Mitte mit einer verwachsenen Querwand;" and Schærer (Enum. 174) describes the sporidia as "spore simplices;" but in Zwackh's and Schærer's specimens, cited above, I have found them distinctly uniseptate, though with simple or indistinctly septate ones occasionally intermixed. In Heppé, 157! they were chiefly all simple. *C. nigricans*, Fries, moreover, has its habitat on trees, "ad quercus;" but *C. citrina* occurs only on stones.

The only *Calicium* with stipitate apothecia that I know of, which grows on stones or rocks, is *C. corynellum*, Ach., which I have in my herbarium from Upsal! Fries fil.; Fontainebleau! Nyl. and Zwackh, 141! This, indeed, has a citrine pulverulent thallus, but then the disk of the apothecium is of a deep raven-black, surrounded by a thin prominent margin, and the stipes of a paler but decided black and smooth. The sporidia also are uniseptate and brown, but the extremities of the cells being peculiarly pointed or cuspidate, give them an unmistakeable appearance, altogether different from the plain rounded extremities of those of *C. citrina*, to say nothing of their difference in size (see Plate VIII. fig. 19). Moreover, *C. corynellum*, Ach. is a true *Calicium* with a carbonaceous excipulum, whilst *C. citrina* has the excipulum pale, and not carbonaceous,—a structure better described by comparison, as in the words of Dr. Nylander (Nouv. Classif. cit. s.) "est genus *Coniocybe*, quoad apothecia, ad *Calicium*, ut *Biatore* Fr. ad *Lecideam* Fr.; vix aliter invicem differunt."

Of this lichen I propose to give examples in the forthcoming 9th fasciculus of my 'Lichenes Britannici Exsiccati.'

PLATE VIII. fig. 7. *Coniocybe citrina*, Leight., nat. size. Fig. 8. Apothecium of *C. citrina*, highly magnified. Fig. 9. Sporidia of *C. citrina*, highly magnified. Fig. 10. Supposed apothecia of *Biatore lucida*, Fries, nat. size. Fig. 11. The same, magnified. Fig. 12. Vertical section of supposed apothecium of *B. lucida*. Fig. 13. Supposed sporidia of *B. lucida*. Fig. 14. Sporidia of *C. furfuracea*, Ach., and its varieties. Fig. 15. Sporidia of *C. gracilenta*, Ach. Fig. 16. Sporidia of *C. pallida*, Fries, and its varieties; and of *C. farinacea*, Chev. Fig. 17. Sporidia of *C. hyalinella*, Nyl. Fig. 18. Sporidia of *C. nigricans*, Fries. Fig. 19. Sporidia of *Calicium corynellum*, Ach. Fig. 25. Scale of magnitude of the sporidia only.

Sphinctrina septata, Leight. Apothecia parasitic, stipitate, dark brown; stipes short, stout and smooth; excipulum clavato-pyriform, truncate, incurved at the margin; disk depressed, dark brown; sporidia in asci, eight, very large, elliptical, 3-septate, umber-colour; cells granular.

Sphinctrina septata, Leight. Lich. Brit. Exs. 2281 (1856).

Parasitic on the thallus of *Thelotrema lepadinum*, Ach., and on holly. Ingleby Park, Cleveland, Yorkshire! Mr. W. Mudd.

Thallus undistinguishable from that of the matrix, or a mere film on the bark of the holly. *Apothecia* apparently bursting through the bark, either singly or in groups of two or three together, stipitate, about $\frac{1}{4}$ of an inch high, of a rich dark-brown colour, more or less polished and shining. *Stipes* smooth. *Excipulum* clavato-pyriform, truncate at the summit, and incurved at the round depressed orifice. *Disk* minute, dark brown. *Asci* linear. *Paraphyses* very long and slender. *Sporidia* eight, very large, elliptical, pointed at the extremities, generally rather broad, sometimes narrower and more elongated, of an umber-colour, 8-septate, the cells filled with round granules.

The immense sporidia preserve this as quite distinct from any other species of *Sphinctrina*.

This lichen we owe to the research of Mr. W. Mudd.

PLATE VIII. fig. 20. *Sphinctrina septata*, Leight., nat. size. Fig. 21. Apothecia, magnified. Fig. 22. Orifice of apothecium. Fig. 23. Section showing asci, sporidia, and paraphyses. Fig. 24. Sporidia, highly magnified. Fig. 25. Scale of magnitude of the sporidia only.

XI.—On the so-called "Water-vascular System." By THOMAS WILLIAMS, M.D., F.L.S., Physician to the Swansea Infirmary.

To the Editors of the *Annals and Magazine of Natural History*.

GENTLEMEN,

MY recent researches have convinced me that the ideas of naturalists with reference to the so-called "water-vascular system" in the Annulose and Radiated classes, as most probably in the entire subkingdom of the Invertebrated animals, must undergo a radical change.

Already, in another place, I have pointed out that the ciliated tubes in the Rotifera, to which this title has been given, have nothing whatever to do with water, unless the cavitary nutritive fluid be called by that name.

1. At one time I supposed that the convoluted cords described by Hollard, Frey and Leuckart, in the perivisceral spaces of *Actinia*, were in truth a rudimentary "water-vascular system." But I now believe that they have no relation whatever to such a system; that, on the contrary, they are *organs* upon which is engrafted the reproductive apparatus, and by which at the same time is fulfilled the function of discharging externally the fluid contained in the perivisceral cavity.

2. I am convinced from recent observations that the so-called "water-vascular system" (Siebold and others) of the Trematode

and Cestoid Entozoa, has no reference whatever to such a function; that in the latter animals the mis-called water-canals are really nutritive channels; that they are probably furnished with a suctorial and an excretory extremity; and that what has been described as the ciliated "water-tubes" in the Trematodes *do not carry water at all*, under any conditions or circumstances.

3. That in the entire family of the *Medusæ* there exists no structure which is entitled to be styled a water-vascular system.

4. That in the Echinodermata there is no system of vessels which carries water, in the respiratory sense of that phrase; that the contents of the *ambulacral system* are not pure water, but on the contrary a fluid drawn from the cavitory reservoir, and destined to be eliminated externally, like the contents of the vascular system of the Annelida; that from the analogy of all the facts now known, it is in the highest degree probable that the "*branchial tree*" of *Holothuria* is not branchial at all; and that it does not suck-in water from without under any circumstances.

5. That in the entire family of the Annelida no system of organs can be discovered which deserves to be called a water-vascular system.

There can be no doubt that the hæmotosine and metallic compounds which accumulate in the vascular fluid system of this class prove that it is intended, where it is present, to fulfil, in an express manner, a *respiratory function*, and therefore corresponds with

6. The tracheal system of Insects.

But in the former instance the external aërating medium is not admitted *directly into* the vessels, as in the latter. This point is one of material difference. An *aërial-vascular system* is thus proved to exist, but *not a water-vascular one*.

7. I have not been able to prove in any instance among the Crustacea and Mollusca that *water* is directly and immediately admitted into *any one* of the systems of vessels or channels communicating with the *interior of the body*.

8. The preceding corollaries are founded upon a vast number of practical details (which will be published at length in my work on the Respiratory Organs), which have led me, step by step, to the conclusion that a *real "water-vascular system"* has no existence in any class of Invertebrated animals; and that really there is not a single example amongst the Invertebrata of that method of breathing which has been called "*internal aquatic respiration*."

I remain, Gentlemen,

Your obedient Servant,

THOMAS WILLIAMS.

Swansea, Jan. 12, 1857.

XII.—*A Synopsis of the British Edriophthalmous Crustacea.*

By C. SPENCE BATE, F.L.S. &c.—Part I. AMPHIPODA*.

CLASS CRUSTACEA.

Legion II. EDRIOPHTHALMA.

Order I. AMPHIPODA.

Group A. NORMALIA.

Division I. GAMMARINA.

Subdivision I. VAGANTIA.

Do not construct abodes to dwell in.

Tribe I. *Saltatoria*.

Mode of progression out of the water is by leaps.

Family I. *Orchestidæ*.

The upper antenna shorter than the lower. The coxæ well developed; the posterior pleopoda short and robust, the last being single.

Genus 1. *ORCHESTIA*†.

Upper antenna rudimentary; the lower with the basal joints absorbed within the facial wall of the cephalic segment. Olfactory spine absent. The second pair of feet subcheliform.

Subgenus 1. *Talitrus*, Latr., Bosc, Leach.

First pair of feet simple in both sexes.

1. *T. Locusta*, Latr. Second pair of feet feeble, terminating in a subcheliform hand, and folded beneath the body; the dactylos small, and articulating remote from the apex of the propodos. The last pair of the posterior pleopoda rudimentary. The telson obsolete.

Sandy shores all round Europe, at high-water mark.

Subgenus 2. *Talorchestia*, Dana.

First pair of feet simple in female only.

[Of this subgenus there is no British species known.]

* The classification adopted in this Synopsis is the result of the united labours of Mr. Westwood and the author; it is based on the structure and the habits of the animals as far as known. The characters given are only those which more immediately strike the observer. Many of the terms employed are new; they are explained at the end of this paper.

† The classification adopted in this genus is that given by Dana, and the result of his discovery of the intermediate form of *Talorchestia*.

Subgenus 3. *Orchestia*, Leach.

First pair of feet simple in neither sex.

1. *O. littorea*. The first pair of hands minute, subcheliform in both sexes; second pair large and powerful in the male, feeble and similar to those of *Talitrus* in the female.

Rocky shores all round Europe, including the Crimea, at high-water mark.

2. *O. Deshayesii*. Hand of the second pair of feet having the posterior portion of the palm armed with a strong tooth.

Plymouth, Dr. E. Moore.

3. *O. levis*, mihi. Second hand in male long and triangular, and without a thumb or tooth on the palm.

Swansea, C. S. B.

Genus 2. *ALLORCHESTES*, Dana.

Upper antenna about half the length of the under. The basal joints of lower antenna not completely fused into the facial wall of the head. Olfactory spine rudimentary. The first two pairs of feet subcheliform. Mandible non-palpigerous.

1. *A. Danai*, mihi. Upper antenna reaching to the termination of the peduncle of the inferior; the lower one-third the length of the animal. The first pair of feet considerably smaller than the second; the posterior edge of the palm of the latter terminating in an obtuse point.

Moray Frith, Rev. G. Gordon. Penzance, G. Barlee, Esq., W. Webster, Esq. Falmouth, W. Webster, Esq.

2. *A. imbricatus*, mihi. Upper antenna longer than the peduncle of the lower. The central edge of the dorsal surface keel-shaped, each of the segments being surmounted by a small tubercle.

Penzance, G. Barlee, Esq.

Genus 3. *GALANTHIS* (mihi).

Lower antenna scarcely longer than the upper. Mandible non-palpigerous. Posterior pleopoda Orchestiform. Telson divided.

1. *G. Lubbockiana* (mihi). Antennæ subequal. Hands of both pairs of gnathopoda subcheliform and subequal.

Falmouth, W. Webster, Esq. Penzance, — Harris, Esq., G. Barlee, Esq.

Tribe II. *Natatoria*.

Mode of progression is by swimming. Cannot leap or walk when out of the water.

Family II. *Gammaridæ*.

Body compressed. Legs long and slender. Posterior pleopoda well developed, the last being generally the longest.

Subfamily I. *STEGOCEPHALIDÆ*.

Antennæ subequal. Coxæ of the four anterior legs immensely developed.

Genus 1. *MONTAGUA* (mihi).

Upper antenna without secondary appendage. Mandibles non-palpigerous. Hands of both gnathopoda subcheliform. Posterior pleopoda single-branched. Telson entire.

1. *M. monoculoides* (Montagu). Second joint of the peduncle of the upper antenna shorter than the first. Palm oblique, occupying only half the length of the hand.

S. Coast of Devon, *Montagu* (*Linn. Trans.* vol. xi.). Plymouth, *Howard Stewart, Esq., C. S. B.*

2. *M. marina* (mihi). Palm nearly the whole length of the inferior side of the hand.

Macduff, *Mr. Gregor*. Banff, *Mr. Edwards*. Plymouth, from trawlers, *C. S. B.*

3. *M. Alderii* (mihi). Hand square, furnished with a small thumb; palm denticulated.

Coast of Northumberland, *J. Alder, Esq.*

4. *M. pollexiana* (mihi). Hand of second gnathopod furnished with a large thumb, which is formed by a deep cleft in the palm.

St. Ives, *G. Barlee, Esq.*

Genus 2. *DANAIA* (mihi).

First pair of gnathopoda simple; last pair of pleopoda with a single stylet.

1. *D. dubia* (mihi). Coxæ of the second, third and fourth pairs of legs denticulated at the margin.

Subfamily II. *LYSIANASSIDÆ*.

Upper antenna short, pyriform. Second gnathopod long, feeble, and obsoletely subcheliform.

Genus 3. *LYSIANASSA* (Edwards).

Upper antenna furnished with a secondary appendage. First gnathopod simple. Telson simple.

1. *L. Costæ* (Edwards). Inferior antenna scarcely longer than the superior.

Plymouth, C. S. B.

2. *L. Audouiniana* (mihi). Inferior antenna much shorter than the superior. Filamentary appendage to the superior rudimentary.

Plymouth, C. S. B.

3. *L. Chausicæ*, Edwards (?). Lower antenna longer than the upper, and longer than the entire animal.

Plymouth, C. S. B.

4. *L. marina* (mihi). Lower antenna longer than the upper, but not half so long as the entire animal.

Plymouth Sound, C. S. B. Banff, Mr. Edwards.

Genus 4. *SCOPELOCHEIRUS* (mihi).

Upper antenna furnished with a secondary appendage. First pair of gnathopoda terminating in a brush; second, cheliform. Telson double.

1. *S. crenatus*. Head furnished with a small rostrum. Upper antenna very large at the base. Secondary filament consisting of but one articulation. A deep notch in the second segment of the anterior pleon.

Banff, Mr. Edwards. Plymouth, C. S. B.

Genus 5. *ANONYX* (Kröyer).

First gnathopod subcheliform. Telson squamiform, with a central division.

1. *A. Edwardsii* (Kröyer). Lower antenna scarcely longer than the upper.

Moray Frith, Rev. G. Gordon. Plymouth Sound, C. S. B. Falmouth, W. Webster, Esq. Banff, Mr. Edwards.

2. *A. minutus* (Kröyer). Lower antenna nearly three times as long as the upper. The squamiform coxæ of the two posterior legs produced so as to cover the two next succeeding articulations.

Plymouth Sound, C. S. B.

3. *A. Holbolli* (Kröyer). The squamiform development of the posterior legs not produced so as to cover the two next succeeding articulations.

Moray Frith, Rev. G. Gordon. Plymouth Sound, C. S. B.

4. *A. Ampulla* (Kröyer). Lower antenna five times as long as upper.

Moray Frith, *Rev. G. Gordon*. Banff, *Mr. Edwards*.

5. *A. denticulatus*. Posterior and inferior extremity of the second and third segments of the anterior pleon produced into a tooth-like process.

Moray Frith, *Rev. G. Gordon*. Banff, *Mr. Edwards*.

Subfamily III. **TETROMATIDÆ.**

Eyes four: not compound. Upper antenna in advance of the lower.

Genus 6. **TETROMATUS*** (mihi).

Head projecting forwards as a snout. Upper antenna proceeding from the extremity; lower situated far posteriorly. Mandible palpigerous. Gnathopoda but imperfectly prehensile.

1. *T. typicus*. Head and anterior segments much compressed. Upper antenna half as long as the lower, the lower as long as the animal. Posterior margin of the last segment of the anterior pleon *not ornate*.

Moray Frith, *Rev. G. Gordon*. Plymouth, *F. P. Smyth, Esq., C. S. B.*

2. *T. Bellianus*. Upper antenna not so long as the peduncle of the lower. Posterior edge of the last segment of the anterior pleon *ornate*.

Moray Frith, *Rev. G. Gordon*. Plymouth Sound, *C. S. B.*

Subfamily IV. **PONTOPOREIDÆ.**

The shell of the head developed anteriorly beyond the head so as to look like a hood. Upper antenna situated in advance of the lower.

Genus 7. **WESTWOODIA** (mihi).

Shell of the head produced to a point. Upper antenna not appendiculated. Telson entire.

1. *W. cæcula* (mihi). Eyes converging into a single organ, situated above and in advance of the superior antenna. Head not produced into a rostrum. First gnathopod sub-prehensile; second gnathopod simple, fringed on the anterior margin of the *propodus* with a brush of hair.

Moray Frith, *Rev. G. Gordon*. Plymouth, from trawlers, *C. S. B.*

* It is not improbable that it will be necessary to yield this genus to that of *Pseudophthalmus* of Stimpson (*Nat. Hist. of Grand Manan*, which work the author has only seen since this paper has been in type); the only doubt resting on the form of the third and fourth pairs of legs. In the American genus they are "elongated, tapering, with the second joint very small, the third expanded to a hand." In *Tetromatus* they are slight and tapering, with the terminal joint exceedingly long and styliform.

Genus 8. KRÖYER[†] (mihi).

Westwoodia (mihi), Brit. Assoc. Rep.

Head like *Westwoodia*. Hands of gnathopoda well developed, and formed by the *carpus* being produced so as to meet the apex of the *dactylos*.

1. *K. carinata*. The last two segments of the pereion and those of the anterior pleon strongly carinated.

Banff, Mr. Edwards.

Genus 9. PHOXUS (Kröyer).

Cephalic segment produced into a rostrum. Upper antenna with two terminal filaments. Mandible palpigerous. Gnathopoda subcheliform. Last pair of legs very small.

1. *P. Kröyerii* (mihi). Upper antenna reaching scarcely beyond the extremity of the rostrum; lower antenna much longer. Plymouth, C. S. B.

2. *P. Holbolli* (mihi). The peduncle of the upper antenna reaching quite to the extremity of the rostrum; the lower scarcely longer than the upper.

Plymouth, C. S. B.

3. *P. plumosus* (Holboll). Upper antenna reaching beyond the lower. The penultimate segment of the peduncle of the lower produced inferiorly into a scale-like process. Hair upon the animal plumose.

Plymouth, C. S. B.

Genus 10. SULCATOR (mihi), Ann. Nat. Hist. 1852.

Bellia (mihi), Ann. Nat. Hist. 1851; Dana.

Upper antenna with two filaments. Gnathopoda scarcely prehensile. Telson double.

1. *S. arenarius* (mihi). Anterior coxæ largely developed. Upper antenna not longer than the lower. Basis of three posterior pereopoda developed in the form of scales. *Dactylos* of the same obsolete.

Falmouth, Dr. Leach, MS. (Brit. Mus. Coll.). Glamorganshire, C. S. B. Moray Frith, Rev. G. Gordon.

2. *S. marinus* (mihi). Basis of three posterior pereopoda not developed in the form of scales.

Banff, Mr. Edwards. Macduff, Mr. Gregor.

Subfamily V. GAMMAI

The upper antenna not in advance of the lower, and never

rudimentary. Gnathopoda generally prehensile. Last pair of posterior pleopoda terminating in two stylets which are more or less fringed with cilia.

Genus 11. DARWINIA (mihi).

Pereion inflated. Upper antenna without secondary appendage. All the feet terminating in simple hooks, not subcheliform.

1. *D. compressa* (mihi). Head produced into a rostrum. Posterior pleon slender and weak, lying compressed beneath the body of the animal. Upper antenna stouter and longer than inferior. Telson single, lanceolate.

Banff, *Mr. Edwards*. Macduff, *Mr. Gregor*.

Genus 12. IPHIMEDIA (Rathke).

Not compressed. Upper antenna without secondary appendage. Telson simple. First gnathopod simple; second subcheliform.

1. *I. obesa* (Rathke). Head produced into a rostrum. Upper antenna as long as the lower. The last segment of the pereion and all the segments of the anterior pleon armed on the dorsal ridge with two parallel spines.

Tenby, *W. Webster, Esq.* Macduff, *Mr. Gregor*. Plymouth, *C. S. B.*

Genus 13. ACANTHONOTUS (Owen).

First gnathopod subcheliform. Telson divided. Mandible palpigerous.

1. *A. Owenii* (mihi). Head armed with a rostrum. Four anterior segments of the pleon produced on the dorsal surface posteriorly into a strong spine, the posterior margins also denticulated laterally. Anterior coxæ produced each to a point, the fifth directed posteriorly.

Banff, *Mr. Edwards*. Macduff, *Mr. Gregor*.

Genus 14. DEXAMINE (Leach).

Upper antenna with the third articulation of the peduncle reduced in length to that of the filament. Mandible non-palpigerous. Telson divided.

1. *D. spinosa* (Montagu). Head with a short rostrum. Upper antenna with the second articulation longer than the first. Four anterior rings of pleon produced dorsally into a spine posteriorly.

S. Devon (*Montagu, Brit. Mus. Coll.*), *Linn. Trans.* vol. xi. Plymouth, *C. S. B.* Penzance, — *Harris, Esq., W. Webster, Esq.* Macduff, *Mr. Gregor*.

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2. *D. bispinosa*. Second segment of upper antenna not so long as the first. Two anterior segments only of pleon produced into a spine.

Plymouth, C. S. B. Penzance, — *Harris, Esq.* Moray, *Rev. G. Gordon*. Falmouth, *W. Webster, Esq.* Macduff, *Mr. Gregor*.

8. *D. Gordoniana*. First segment of posterior pleon furnished with a spine.

Moray, *Rev. G. Gordon*.

4. *D. fucicola* (Edwards).

Amphitoe fucicola (Edwards). *Pherusa fucicola* (Leach).

With no dorsal spine.

Falmouth, *W. Webster, Esq.* Youghal, Ireland, *R. Ball, Esq.* (*Ann. Nat. Hist.* Oct. 1847).

Genus 15. *CALLIOPE* (MS. Leach).

Upper antenna without secondary appendage. All the feet with strong semi-prehensile claws. Telson single. Mandible palpi-gerous.

1. *C. Leachii* (mihi). Antennæ subequal. First and second gnathopoda subcheliform, subequal.

Moray, *Rev. G. Gordon*. Devonshire?, *Dr. Leach* (*Brit. Mus. Coll.*).

Genus 16. *ISÆA* (Edwards).

Upper antenna with secondary appendage. All the feet prehensile. Telson reduced.

1. *I. Montagui* (Edwards). Upper antenna rather longer than lower. First gnathopod smaller than second.

Plymouth, C. S. B.

Genus 17. *LEMBOS* (mihi).

Upper antenna with secondary appendage small. First gnathopod larger than the second. First of the posterior pereopoda very short, the last very long. Telson rudimentary.

1. *L. Cambriensis* (mihi). First hand without a thumb.

Glamorganshire, C. S. B.

2. *L. versiculatus* (mihi). First hand without a thumb. Second scarcely prehensile, the carpus and meros furnished with a strong brush.

Plymouth, C. S. B.

3. *L. Websterii* (mihi). First hand with a thumb on propodes. Falmouth, *W. Webster, Esq.*

4. *L. Damnoniensis* (mihi). First hand with a thumb on carpus.

Genus 18. *LONCHOMERUS* (mihi).

Like *Lembos*. Meros of first gnathopod produced into a long spine.

1. *L. gracilis*. Spine of meros of first gnathopod as long as the carpus; carpus longer than propodos. Dactylos ornate.

Polperro, Mr. Loughrin. Glamorgan; Plymouth, C. S. B.

Genus 19. *EURYSTHEUS* (mihi).

First gnathopod smaller than the second. Upper antenna with secondary appendage. Telson cylindrical.

1. *E. tridentatus* (mihi). Palm of second gnathopod convex, furnished with three obtuse teeth.

Plymouth, C. S. B. Macduff, Mr. Gregor.

Genus 20. *GAMMARELLA* (mihi).

Antennæ like *Gammarus*, and upper with secondary appendage. Last pair of pleopoda with a single branch. Telson single.

1. *G. orchestiformis*. Upper antenna longer than the lower. Hand of first gnathopod small; hand of second very large and oval. Caudal appendages short.

Polperro, Mr. Loughrin.

Genus 21. *AMATHIA* (Rathke).

Upper antenna with secondary appendage. The telson entire. The animal Ganimariform.

1. *A. carinata* (Rathke). Head with a small rostrum. Centre of the dorsal surface surmounted by a distinct carina commencing at the head and terminating with the caudal segments.

Banff, Mr. Edwards. Crimea, Rathke.

Genus 22. *GAMMARUS* (Fabr.).

Body compressed. Antennæ long and slender, with a secondary appendage to the upper. Posterior pleopoda two, branched. Telson double.

1. *G. Sabinii* (Leach).

G. Moggridgii (mihi) (Ann. Nat. Hist. 1851).

Head with a short rostrum. Dorsal surface marked with a carina commencing about the fourth segment and terminating at the caudal appendages.

Arctic Regions, — *Sabine*. Banff, Mr. Edwards. Menai Straits, J. Alder, Esq. Glamorgan, C. S. B.

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2. *G. carinatus* ? Johnston.

Berwickshire coast, Dr. Geo. Johnston (*White's Catalogue of the British Crustacea*).

3. *G. Locusta* (Fabr.). Upper antenna not much longer than lower. Stylets of the last of the posterior pleopoda subequal. All round Europe.

4. *G. fluviatilis* (Edwards). Scarcely differs from *G. Locusta*. Freshwater streams. Wales; Devon, C. S. B. Duddingston near Edinburgh, Dr. Leach (*White's Cat. Brit. Crust.*).

5. *G. Pulex* (Fabr.). Resembles *G. fluviatilis*. Spines upon the posterior portion of the abdomen*. Freshwater streams. Ireland (Loch Neagh), W. Thompson, Esq. (*White's Catalogue of the British Crustacea*).

6. *G. gracilis*. Upper antenna much longer than the lower. Last pair of the posterior pleopoda with the stylets unequal. Plymouth, C. S. B. Crimea, Rathke. Probably all round Europe.

7. *G. campylops* (Leach). Eye in form of the letter S. Isle of Arran (near Loch Ranza), Dr. Leach's Coll. (*White's Cat. Brit. Crust.*). Belfast, Thompson (*Ann. Nat. Hist.* 1847).

8. *G. marinus* (Leach). Antennæ short and robust. Hands of the gnathopoda truncated in appearance. The stylets of the last of the posterior pleopoda subequal. Starcross, C. S. B. Strangford Lough, Mr. Hyndman (*Ann. Nat. Hist.* Oct. 1847). Sligo, Mrs. Hancock (*Ann. Nat. Hist.* Oct. 1847). Devonshire, Dr. Leach (*Linn. Trans.* vol. xi.).

9. *G. palmatus* (Montagu).

Melita palmata (Leach).

First gnathopod with a very small hand; second with hand very large and square. Dactylos scimitar-shaped. Devon, Montagu. Plymouth, C. S. B.

10. *G. Othonis* (Edwards). Hands subequal, long, and narrow towards the extremity. The last of the pleopoda with stylets equal. Plymouth, C. S. B.

* This description is taken from M. Milne-Edwards's *Histoire des Crustacés*.

11. *G. longimanus* (Leach). Second hand much larger than the first, very long, and not narrowing towards the extremity. Last caudal stylets equal.

(Leach, *Brit. Mus. Coll.*) Belfast, Thompson (*Ann. Nat. Hist.* Oct. 1847). Plymouth, C. S. B.

12. *G. brevicaudatus* (Edwards). Lower antenna not reaching to the extremity of the peduncle of the upper. Last pair of caudal stylets extremely short.

Plymouth, C. S. B.

18. *G. grossimanus* (Montagu).

Mæra grossimana (Leach).

Coxæ not largely developed. Hand of second gnathopod very large.

Plymouth, C. S. B. Devonshire, Montagu.

14. *G. inæquimanus* (mihi). The second pair of gnathopoda has the left hand four times as large as the right. A dorsal spine on the first segment of the posterior pleon, and two smaller placed laterally on the next.

Polperro, Mr. Loughrin.

15. *G. ? pallidus* (mihi). Upper antenna shorter than the lower. Hands large, with dactylos well developed, and fringed internally with teeth.

Plymouth, C. S. B.

16. *G. maculatus* ? (Johnston).

17. *G. ? subterraneus* (Leach).

Well in London.

Genus 23. *UROTHOE* (Dana).

Upper antenna scarcely longer than the peduncle of the lower. Coxæ moderately developed. Gnathopoda prehensile. The dactylos of the other feet styliform. Telson double.

1. *U. elegans** (mihi).

Gammarus elegans (mihi), Brit. Assoc. Report.

Hands of gnathopoda very small. Upper antenna shorter than the lower. Last pair of pleopoda with the stylets feathery and subequal.

Plymouth, C. S. B.

* This species scarcely differs from *U. irrostratus* of Dana, which however, having been taken in the Sooloo Sea, can scarcely be supposed to belong to the same species as the British form.

Genus 24. *NIPHARGUS* (Schjödte).

1. *N. Stygius* (Westwood).

Deep well in Central England.

Genus 25. *THERSITES* (mihi).

Upper antenna with second joint of peduncle produced from the inferior side of the first. Second gnathopod terminating in a brush. Telson double.

1. *T. Guillemsioniana*. Inferior antenna as long again as the superior.

Weymouth, *Prof. Williamson*.

2. *T. pelagica*. With the inferior antenna six times as long as the superior.

Moray Frith, *Rev. G. Gordon*.

Subfamily VI. *LEUCOTHOIDES*.

Carpus on both pairs of gnathopoda developed into a thumb to the hand.

Genus 26. *LEUCOTHOE* (Leach).

The process of the carpus on the first gnathopod as long as the propodos. The hands of the second oval and larger than those of the first. Telson single.

1. *L. articulosa* (Mont.). Head furnished with a short down-curved rostrum. Lower antenna shorter than the upper. Telson long and lanceolate.

Plymouth, *C. S. B.* Moray Frith, *Rev. G. Gordon*.

2. *L. procera* (mihi). Hand of the first gnathopod short, of the second long, and narrower than in *L. articulosa*. The palm denticulated.

Banff, *Mr. Edwards*.

Subdivision II. *DOMICOLA*.

Being those of the normal *Gammarina* which live in abodes of their own construction: some burrow in wood, some in clay; some erect tubes of mud, or stones and weed, and others build nests with materials united by a substance secreted by the animal.

Family III. *Corophiidae*.

With the segments of the pleon not fused together.

Section I. *Nidifica*.

Comprising those which construct their own nests.

Subfamily I. **PODOCERIDEA**.

The peduncle of the upper antenna much shorter than that of the lower. Lower antenna very strong, and used in climbing. Last pair of pleopoda terminating in short strong hooks.

Genus 1. **PLEONEXES** (mihi.)

Upper antenna without secondary appendage. Peduncle of the lower antenna reaching nearly to the extremity of the upper antenna. The gnathopoda subcheliform. Posterior pereopoda prehensile.

1. *P. Gammaroides*. Lower antenna not pediform. Second gnathopod with hand nearly square and larger than the first.
Penzance, *G. Barlee, Esq.*

Genus 2. **AMPHITOË** (Leach).

Filament of the upper antenna long and slender; filament of lower not pediform. Gnathopoda subequal. Posterior pereopoda subprehensile. Posterior pair of pleopoda with one branch terminating in hooks, the other squamiform. Telson simple.

Build nests made of weed and material of their own secretion.

1. *A. rubricata* (Montagu). Filament of the upper antenna extending far beyond that of the lower.

Plymouth, *Col. Montagu, C. S. B.* Strangford Lough, *Thompson (Ann. Nat. Hist. Oct. 1847).*

2. *A. littorina* (mihi).

A. punctata, Johnston (not Say).

Antennæ subequal. Construct nests with a material apparently secreted by the animal.

Coast of Berwickshire, *Johnston (White's Catalogue of the British Crustacea)*. Spring Vale, co. Down, *Thompson (Ann. Nat. Hist. 1847)*. Plymouth, *C. S. B.* Probably all round our coasts.

Genus 3. **SUNAMPHITOË** (mihi).

Second gnathopod larger than the first. Posterior pleopoda with one branch squamiform, the other terminating in two hooks. Telson terminating in a single strong hook.

1. *S. Hamulus* (mihi). Antennæ subequal. Posterior pereopoda scarcely prehensile.

Moray Frith, *Rev. G. Gordon*. Penzance, — *Harris, Esq.*

2. *S. conformata* (mihi). Upper antenna longer than the lower. Posterior pereopoda subprehensile.

Plymouth, *C. S. B.*

Genus 4. *PODOCERUS** (Leach).

Upper antenna with a rudimentary second filament. Lower antenna pediform, and terminating in strong spinous hooks. Posterior pleopoda with one branch styliform, the other terminating in hooks.

Construct nests.

1. *P. falcatus* (Montagu). Hand of the second gnathopod large, with a tooth pointing anteriorly in the middle of the palm. Plymouth; Wales, C. S. B. Devon, Montagu.
2. *P. variegatus* (Leach). Hand of second gnathopod large, without a tooth on the palm. Plymouth, C. S. B. Bell Rock, Stevenson (*White's Catalogue of the British Crustacea*).
3. *P. pulchellus* (Leach). Hand of second gnathopod large, with a well-developed thumb at the posterior extremity of the palm. Plymouth, H. Stewart, Esq., C. S. B. Swansea, C. S. B. Banff, Mr. Edwards.
4. *P. punctatus* (Edwards, MS. Brit. Mus.). Antennæ subequal; inferior not pediform. Carpus of the gnathopoda forming part of the hand. Dactylos on all the limbs denticulated. Telson rudimentary. Northumberland, J. Alder, Esq.

Genus 5. *CYRTOPHIUM* (Dana).

Pereion inflated; pleon compressed. Posterior pleopoda rudimentary. Telson squamiform.

1. *C. Darwinii*. Dorsal surface imbricated. First of the posterior pleopoda longer than the second. Falmouth, W. Webster, Esq.

Section II. *Tubifica*.

Dwell in tubes, some formed by burrowing, some constructed by the union of materials.

Subfamily II. *CERAPIDES*.

Construct abodes by the union of materials.

Genus 6. *ERICTHONIUS* (Edwards).

Lower antenna not pediform. Thumb developed on carpus of

* It is usual to divide this genus into two, *Podocerus* and *Jassa*, but there is great reason to believe that the difference is merely sexual. It is evidently synonymous with Dana's genus *Cratophium*; the species *C. validum* being almost identical with *P. pulchellus*.

the second gnathopod. Posterior pleopoda single-branched, terminating in hooks. Telson furnished with curved spines.

1. *E. difformis*. Thumb on the second gnathopod two-pointed. Swansea, Plymouth, C. S. B.

Genus 7. SIPHONOCETUS (Kröyer).

Lower antenna subpediform, longer than upper. First and second gnathopoda prehensile. Posterior pleopoda single-branched, terminating in hooks. Telson furnished with teeth or hooks. Posterior pereopoda terminating in curved spines.

1. *S. Kröyeranus* (mihi). Upper antenna short. Dactylos of the anterior pereopoda styliform and without a curve.

Weymouth, Prof. Williamson.

2. *S. crassicornis*. Basal joint of upper antenna having the anterior superior margin developed into a *horn* reaching to the end of the second joint.

Northumberland, J. Alder, Esq.

Subfamily III. COROPHIIDÆ.

Construct abodes by burrowing in clay or mud, &c.

Genus 8. COROPHIUM (Latreille).

Lower antenna very large, much more powerful than upper, pediform. Gnathopoda not prehensile. Posterior pleopoda short and single-branched.

1. *C. longicorne*. Lower antenna longer than the whole animal. Filament fused into a single articulation. A large tooth on the inferior surface of the penultimate joint of the peduncle.

Moray Frith, Rev. G. Gordon. Glamorgan; Devon, C. S. B. Medway, Dr. Leach, Coll. Brit. Mus. (*White's Cat. Brit. Crust.*)

Family IV. Cheluridæ.

The three segments of the posterior pleon fused into a single joint.

Construct abodes by burrowing in wood, &c.

Genus 1. CHELURA (Philippi).

Upper antenna shorter than lower, furnished with a secondary appendage. Lower antenna with segments of filament fused. Telson single.

1. *C. terebrans* (Philippi). Gnathopoda imperfectly cheliform. Last segment of the anterior pleon produced into a large spine dorsally and posteriorly.

Dublin Bay, Thompson. Plymouth, C. S. B. Britain, Dr. Leach (*White's Cat. of the Brit. Crustacea*). Ayrshire, Major Thomson.

Division II. HYPERINA.

Family V. Hyperidæ.

Pleon not folded beneath the pereion. Antennæ well developed and exposed. Pereiopoda not prehensile.

Genus 1. HYPERIA (Latreille).

Head large. Antennæ short. Gnathopoda scarcely prehensile. Telson lanceolate.

1. *H. Galba* (Montagu).

Hyperia Latreillei (Edwards).

The first six or seven articulations of the filament of upper and lower antennæ fused. Upper antenna longer than the lower. Pereiopoda short.

2. *H. obliqua* (Edwards). Lower antenna longer than the upper, and the segment of the filament of the upper antenna only fused. Pereiopoda long.

Moray Frith, *Rev. G. Gordon*.

Family VI. Phronomidæ.

Some of the pereiopoda prehensile.

Genus 1. PHRONOMA (Latreille).

The first of the posterior pereiopoda cheliform.

1. *P. sedentaria* (Latr.). Antennæ short. Feet of first two pairs compressed. The two fingers which terminate the fifth pair of legs are large, curved, and armed with a tooth on the internal border.

Shetland, *Dr. Fleming* (*White's Cat. of the British Crustacea*).

Family VII. Typhidæ.

Antennæ not exposed. Pleon compressed beneath the pereion. The squamiform process of the posterior pereiopoda largely developed, and acting the part of an operculum.

Genus 1. TYPHIS (Risso).

1. *T. nolens* (Johnston) (*White's Cat. of the British Crustacea*).

Group B. ABERRANTIA.

Family VIII. Dyopedidæ.

The last segment of the pereion and the last of the pleon absent. Coxæ of last two pereiopoda fused with the body of the animal.

Genus 1. DYOPEDOS (mihi).

The *sixth* and *seventh* pairs of legs attached to the *sixth* segment of the pereion. The last pair of *pleopoda* absent. Telson single.

1. *D. porrectus* (mihi). Upper antenna half as long as the body. Second gnathopod with a long, straight, spine-like thumb proceeding from the posterior extremity of the palm. Hands not armed in female.

Macduff, Mr. Gregor.

2. *D. falcatus* (mihi). Upper antenna as long as the animal. Thumb at the extremity of the palm, crooked.

Macduff, Mr. Gregor.

Family IX. Caprellidae.

With the pleon rudimentary. Coxæ fused with the body of the animal.

Genus 1. PROTO (Leach).

Legs developed on each segment of the pereion.

1. *P. pedata* (Leach). The palm of second gnathopod convex, and slightly denticulated.

Moray Frith, Rev. G. Gordon. Plymouth, C. S. B.

2. *P. Goodsirii* (mihi). The palm of second gnathopod concave.

Moray Frith, Rev. G. Gordon.

Genus 2. PROTELLA (Dana).

With legs reduced to a rudimentary state on the third and fourth segments of the pereion.

1. *P. longispina*, Kröyer.

Ægina longispina? (Kröyer). *Caprella spinosa*? (Goodsir).

C. Phasma? (Latr.).

With four long spines on the three anterior segments.

Plymouth, C. S. B.

Genus 3. CAPRELLA (Lamarck).

Has no legs developed on the two middle segments of the pereion.

1. *C. linearis* (Latr.). Without spines or rostrum.

Weymouth, P. H. Gosse, Esq. Wales; Plymouth, C. S. B.

2. *C. Pennantii* (Leach). With a rostrum.

Plymouth, Mr. Boswarva.

3. *C. tuberculata* (Goodsir). Spine on head; four tubercles on the fourth segment.

Strangford Lough, Thompson (*Annals*, 1847).

4. *C. lobata* (Müller).

5. *C. acuminifera* (Edwards).

C. acanthifera (Leach).

With three spines on the back of each of the four central segments, two near the centre, and one at the posterior extremity

of each except the last. Head vaulted, craniform. In the female, the spines are reduced to tubercles. :

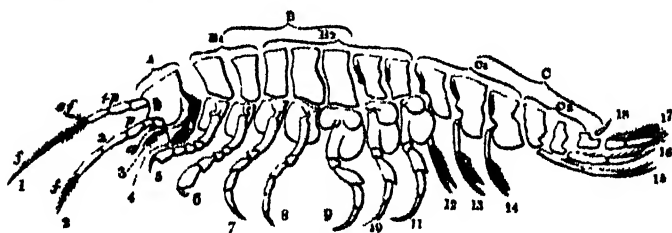
Drake's Island, *G. Barlee, Esq.*

Genus 4. *CYAMUS* (Latreille).

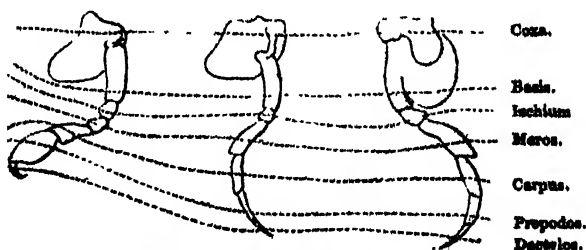
Head small, body depressed. Abdomen rudimentary. Third and fourth pereopoda rudimentary. Inferior antenna rudimentary. Parasitic.

1. *C. Ceti* (Linnæus). Body moderately developed. Branchiæ simple, furnished at the base with two unequal and pointed appendages.
2. *C. ovalis* (Roussel de Vauzème). Body very large. Four pairs of branchiæ to both sexes; those of the third segment have a solitary appendage, while those of the fourth have two.
3. *C. gracilis* (Roussel de Vauzème). Body slight and narrow.
4. *C. —* ?

C. gracilis (Gosse).



- A. Head. B. Pereion. B 1. Anterior pereion. B 2. Posterior pereion. C. Pleon. C 1. Anterior pleon. C 2. Posterior pleon. 1. Upper antenna. 2. Lower antenna. a. Olfactory denticle. p. Peduncle. f. Filament. cf. Complementary or secondary filament. 3. Palp of mandible. 4. Maxilliped. 5 & 6. Gnathopoda. 7 to 11. Pereiopoda. 12, 13, 14. Anterior pleopoda. 15, 16, 17. Posterior pleopoda. 18. Telson*.



These terms are abbreviated from M. Milne-Edwards.

* The terms used in this paper are suggested instead of the old and incorrect synonyms of thorax, abdomen, &c., which authors frequently employ to signify different parts of the animal.

XIII.—*List of Coleoptera received from Old Calabar, on the West Coast of Africa.* By ANDREW MURRAY, Edinburgh.

PART I.

A PART of the West Coast of Africa, about the natural productions of which we knew less than many other parts of the coast, has within the last few years been opened up to us by the establishment of a mission station at Old Calabar. This station has been established by the United Presbyterian Church of Scotland; and most fortunately for science, the missionaries and their assistants who have been sent there, have been not only able and diligent in their proper calling, but also intelligent and observing men, who have availed themselves of their position to make and transmit to this country collections in different branches of natural history. The gentlemen I allude to are the Rev. Hope M. Waddell and the Rev. Mr. Goldie, Mr. W. C. Thomson and Mr. John R. Wylie. From all of these gentlemen collections have been received, from which I have profited, and which have put me in the position of being able to form something like a catalogue of the Coleoptera of that country. I think I may with justice say, that from these sources I possess a larger amount of materials for making up such a catalogue than any other person; and as a great number of the species are new and curious, and the whole are specially interesting in relation to the geographical distribution of species, I propose to give a list of the whole which I have received, intercalating descriptions of those which are new, with figures of the most striking. I shall have my labours in this respect a good deal curtailed by some of our most eminent entomologists, who are working at Monographs of particular groups. To them I have thought it right to entrust the new species in each of their departments; and these have either been already described and published, or are in course of being so. M. Chevrolat has described about fifty of the new *Longicorns*; M. Boheman in his Supplement will describe between twenty and thirty new *Casside*; Mr. Westwood occupies himself with the new *Megalopida*, and M. Suffrian with the new *Cryptocephalida*; and my new *Elaterida* are in the hands of M. Candeze, the first volume of whose work on that great family will probably ere this is printed be in the hands of entomologists.

I am very sensible that in the following pages I shall unavoidably occasionally fall into the error of describing as new, species which have been already described by other authors. The immense number of descriptions of species scattered through foreign Journals and Transactions of Societies, renders it hope-

less to expect to escape such mistakes. I see the ablest and best-informed entomologists, both at home and abroad, constantly falling into them, and I am not so unreasonable or self-confident as to expect a better fate. All I can say is, that when I do commit such errors, they are made "not in consequence of neglect, but in spite of attention."

That such errors are not much more numerous than they will be found to be, is greatly owing to the kindness of my friends, Mr. Adam White of the British Museum, and M. Chevrolat and M. Reiche of Paris, who have on every occasion laid freely open to me the extensive stores of information which they possess,—an assistance the value of which only those who have been engaged on similar works can justly appreciate.

I have not attempted to make this a work of synonymy, but in recording the species which have been already described, I have simply confined myself to giving their names, with one reference to the place where a description will be found; and while I have endeavoured to follow the rule of priority in selecting the name of the species, I have by no means followed that rule in choosing the reference to the description (the oldest descriptions being generally the most insufficient), but I have chosen that which appeared to me the best and was at the same time most generally accessible.

Cicindelidæ.

CICINDELA, Linn.

1. *C. senegalensis*, Dej. 1. 117.

Capite thoraceque viridi-cupreis, subrugosis; elytris viridi-æneis; margine laterali, lunula humerali apicalique, fascia media obliqua sinuata suturaque subsinuata abbreviata, albis.

Long. $4\frac{1}{2}$ lin., lat. $1\frac{1}{2}$ lin.

Only a few specimens have been received of this species. They vary a little from the usual form of *senegalensis* in having the thorax comparatively a little narrower, and the ground-colour of the elytra being less green, it being reddish-brassy with green reflections; but the markings are the same, and it corresponds in other respects; therefore I have no doubt it is merely a variety of *senegalensis*.

2. *C. vicina*, Dej. 5. 244.

Var. *confusa*, mihi.

Subcylindrica, supra cupreo-viridi ænea; elytris margine laterali subinterrupto, lunula humerali subinterrupta, altera apicis

dentata, strigaeque media recurva subinterrupta incumbente, albis; femoribus subtus rufis.

Long. 4-5 lin., lat. $1\frac{1}{4}$ - $1\frac{1}{2}$ lin.

The specimens I have from Old Calabar differ slightly from my other specimens of *vicina*, Dej., but not sufficiently to constitute a distinct species. The labrum is more prominent in the Old Calabar species, but that part varies a good deal in form, and particularly in the development of the three teeth in front. In the males they sometimes appear almost entirely wanting. The first joint of the antennæ in *vicina*, Dej., is green. In the Old Calabar species this joint is either wholly brown, or brown below with a virescent tinge above. The white marks on the elytra are broader in *vicina* than in this variety, and its apical margin of white slopes somewhat parallel with the margin, while in this variety its upper edge is nearly square or parallel with the base; but the breadth, extent and form of the white markings on the elytra vary a good deal in different individuals.

I obtained a specimen identical with my Old Calabar examples from M. Jekel, under the name of *confusa*, Gehin; but I have not been able to ascertain that it has been anywhere described by M. Gehin, whence I presume it is a MS. name, which I have preserved for the variety. M. Jekel's ticket bore "*melancholica*, Fab. non Dej." as a synonym; but I know not on what grounds this statement was made.

Var. *obliteranda*, mihi.

I have two specimens which I also consider as a variety of the above. The white markings on the elytra have here greatly diminished, so that the humeral lunule and middle band have disappeared, leaving only a white spot where they terminated; the distinct white margin has also been attenuated to an interrupted thread along the margin, and it is very little broader at the extreme apex. A more important distinction is that the granulations or punctuations on the thorax are much finer than in the var. *confusa*, in which they are coarse.

8. *C. Lowei*, mihi.

Capite thoraceque obscure cupreis; elytris obscure viridi-æneis; margine laterali intus tridentato, punctis duobus apicem versus albis.

Long. $5\frac{1}{4}$ lin., lat. 2 lin.

Closely allied to *C. Luxerii*, Dej. Dejean's description of *Luxerii* applies to this species, with the following exceptions:—This is rather larger, being $5\frac{1}{4}$ lines in length instead of only $4\frac{1}{4}$,

and proportionately broad. In *Luxerii* there are two small oblique whitish spots, near to and parallel with the angular sides of the scutellum, which are wanting in this species; a longish tear-shaped white spot alongside of the suture, distant from the base about $\frac{1}{3}$ rd of the length of the elytra, is also wanting here. In *Luxerii* there is an oblique triangular spot near the apex, in some examples connected with the margin by a slender band, showing that this is merely a part of an interrupted hooked band. In *Loweii* this spot is confined to a small round or thread-like dot. The white margin is a good deal broader than in *Luxerii*, and a blackish violet-coloured edging on the outer side of the white margin is a good deal more prominent than in that species. The greater extent of the interior obscure space, arising from the larger size of the insect and the want of the small white spots in the middle and towards the base of the elytra, readily distinguish this species from *Luxerii*.

I have received four specimens, all of which are constant in the above characters.

I have named this species after my valued friend, Dr. William Henry Lowe of Balgreen, a naturalist of great ability and acquirements.

4. *C. cincta*, Fab., Dej. 1. 40.

Supra obscura, subtus viridi-cyanea; elytris vitta laterali, punctisque quatuor albis.

Long. $7\frac{1}{2}$ lin., lat. $2\frac{1}{2}$ lin.

A good many specimens of this species have been received; but as it comes in some consignments and does not occur at all in others, it is obviously an insect found at particular seasons only. What these seasons are we have yet to discover.

Carabidæ.

TEFFLUS, Leach.

1. *T. planifrons*, mihi.

Niger; fronte depresso et plano, thorace rugoso; elytris sulcatis, sulcis elevato-punctatis.

Long. 21 lin., lat. 8 lin.

Very similar to *T. Megerlei*, Dej., but a narrower insect; the thorax more particularly is narrower and proportionately more elongate. It is at once distinguished from *Megerlei* by the sculpture on its head. *T. Megerlei* has two deep foveæ on each side of the head between the eyes, and the space between is raised into a height or bump; a deep transverse depression, widest and deepest in the centre, separates the head from the *clypeus*, which has a couple of longitudinal grooves on its sur-

face; another transverse depression separates the clypeus from the labrum. In the present species these depressions and elevations are, with the following exceptions, not visible. The head looks as if a heavy roller had passed over it, smoothing or crushing down all inequalities. The whole head is a flat opaque surface, with the exception of the transverse division separating the labrum from the clypeus, and the clypeus from the rest of the head, and of a couple of oblique lines (they can scarcely be called grooves) tending inwards from the side of the eye. Another difference is observable in the sulcation of the elytra; but as this may be variable, I do not insist so much upon it. In my specimens of *T. Megerlei* the sulcation is as follows:—the first sulcus next the suture comes down to the apex alone; the second is joined before it reaches the apex by the fourth, and encloses the third; the fourth again joins the sixth, enclosing the fifth; and the seventh comes down alone.

In the present species, on the other hand, the first, as in *Megerlei*, comes down alone; but the second, instead of joining the fourth and enclosing the third, joins the sixth; then within these the third and fifth join, and enclose the fourth. Trifling variations in the decidedness with which these junctions take place may be seen even on different elytra of the same insect; but I think the above is the normal character of these two species.

I have received two specimens of *planifrons*. On receiving the first, I was disposed to look upon it as a variety or distortion of *Megerlei*; but as I found the same characters occurring in the second, I am satisfied that it is a good species. These characters, more particularly the levelling of the head, which is very marked in both of my specimens, enable us at once to distinguish them from *Megerlei*.

DRYPTA, Fab.

1. *D. pectoralis*, mihi.

Viridis; ore, pectore, antennis pedibusque rufis; geniculis atris vel fuscis.

Long. $6\frac{1}{2}$ lin., lat. $1\frac{1}{2}$ lin.

The colour above is a decided green, without the blue tinge of *emarginata*, Fab. The labrum, mandibles, palpi and antennæ are rufous, the tips of the mandibles and the end of the first joint of the antennæ becoming fuscous or blackish. There is no blackish ring on the second and third joints, as in *emarginata*. The under side is of the same colour as the upper, with the exception of the breast (*mesothorax* and *metathorax*), which is rufous. The head is oblong-square, extending two-thirds of its length before the eyes, which are not very prominent; it is

deeply and distinctly punctured, somewhat shining on the disk. The thorax is very narrow, elongate, deeply and closely punctured, and pubescent; it is slightly narrowed in front, and a little more so behind; its greatest breadth is about the middle. At first sight from above, it looks as if it were cylindrical, but on being examined from the side, a narrow ridge is seen to run along, forming the margin of the thorax. An indication of a longitudinal line, and of a fovea in the middle of the base, may be traced from the disposition of the punctuation, but nothing more. The elytra are twice as broad as the thorax, elongate, convex, contracted by a sinuation a little behind the base, and widened out posteriorly; their extremity is truncate, and the truncation is somewhat cut-in on each elytron; they are pubescent and strongly punctate-striate; the intervals are somewhat raised and irregularly punctate; the three outer striæ and intervals are curved inwards at the apex and reach the suture, cutting off the inner striæ, so that they do not reach the termination of the elytra. The legs are rufous, with the exception of the ends of the thighs, which are fuscous or blackish.

This species approaches nearest in form to *D. cyanea*, Buq., but is readily distinguished by the red breast, red legs, &c., parts which in *cyanea* are wholly black. It is of a more elongate form than *D. emarginata*, Fab., and one-half longer; its colour wants the bluish tinge of *emarginata*, and the form of the thorax is different.

GALERITA, Fab.

1. *G. femoralis*, mihi.

Nigra, pilosa; antennarum articulo primo femoribusque ferrugineis; thorace oblongo-cordato; elytris sulcatis, interstitiis concavis, subtilissime transversim rugosis, pilosis.

Long. $10\frac{1}{2}$ lin., lat. $8\frac{1}{2}$ lin.

Black, with the exception of the first joint of the antennæ and the thighs, which are ferruginous; the end of the terminal joint of the palpi is slightly ferruginous. The antennæ are pilose, which causes them to look fuscous towards the apex. The head is rather large, elongate, punctate, pubescent, and it has two longitudinal irregular foveæ between the eyes. The clypeus has one or two punctures on its anterior margin. The thorax is broader than the head, though not very much so; it is of an elongate-cordate form, rounded in front, a little narrowed posteriorly; its posterior angles are projecting and slightly raised; the projecting angles are rounded. It is somewhat convex, punctate on the disk, and transversely rugose-

punctate along the margins; it has a slightly marked medial longitudinal line, and a longitudinal depression along each side parallel to the margin. The front of the thorax is emarginate, the base is cut straight. The elytra are oblong, widened behind; each has nine longitudinal raised lines; the interstitial spaces are concave hollows, and under a strong lens they are found to be very finely transversely strigose, and covered with numerous scattered papillæ, from each of which arises a hair. The apex of the elytra is truncate, slightly sinuate towards the suture, which has a tendency to project; the under side is of the same colour as the upper, with the exception of the trochanters and thighs, which are ferruginous. The tips of the thighs are black. The pilose pubescence on this as well as the other species appears to be easily rubbed off.

This species comes very close to *G. africana*, Dej., but is distinguished by the thighs and first joint of the antennæ being red, while in *africana* they are black. The thorax is also somewhat more elongate.

2. *G. gracilis*, mihi.

Nigra, pilosa, elongata; thorace elongato-cordato, fortiter rugoso-punctato; elytris sulcatis, interstitiis concavis.
Long. $9\frac{1}{2}$ lin., lat. 3 lin.

Not to be distinguished from *G. africana*, Dej., except by a comparative description. It is smaller and more elongate; the thorax is proportionally narrower and more elongate; the anterior angles are less rounded, sloping forward to the head more gradually; the head is more deeply punctate, and the thorax more deeply rugose-punctate. The clypeus has the front and anterior margins reflexed; the centre of the front of it is raised, so as to leave a fovea on each side of the anterior margin. Like *africana* it is wholly black, with fuscous or ferruginous hairs beneath the tarsi. The tarsi are more elongate than in *africana*.

3. *G. interstitialis*, Dej. 5. 295.

Nigra; thorace cordato; elytris sulcatis, interstitiis concavis, bilineatis, subtilissime transversim striatis, pilosis.
Long. $9\frac{1}{2}$ lin., lat. 3 lin.

MACROCHEILUS, Hope.

1. *M. grandis*, Dej. 5. 400.

Ater; labro subporrecto, lævigato; clytris elongatis, sulcatis.
Long. 12 $\frac{1}{2}$ lin., lat. 4 lin.

ACANTHOGENIUS, Reiche.

1. *Acanthogenius bimaculatus*, Dej.*

Helluo bimaculatus, Dej. 5. 402.

Acanthogenius bisignatus, Reiche, Ann. Soc. Ent. France, ix. 334.

Ater, punctatissimus; labro rotundato, lævigato; elytris striatis, macula media rotundata pallide flavo-testacea; tarsis rufopiceis.

Long. 6 lin., lat. 2 lin.

PHEROPSOPHUS, Solier.

1. *Ph. marginatus*, Dej. 1. 109.

Capite testacco, puncto verticis nigro; thorace testaceo, margine antico posticoque nigris; elytris costatis, nigris, subparallelis, puncto humerali, margine laterali, fascia media dentata abbreviata, apice, antennis pedibusque testaceis.

Long. 7-8 lin., lat. $2\frac{3}{4}$ lin.

2. *Ph. minor*, mihi.

Capite testaceo, vertice et postice nigro; thorace supra nigro, vel nigro cum macula marginali testacea, subtus nigro, cum margine testaceo; elytris costatis, nigris, postice latoribus, interdum cum puncto humerali testaceo, interdum sine puncto humerali, cum macula media testacea dentata, apice leviter testaceo; pectore testaceo; abdomine nigro; antennis pedibusque testaceis.

Long. $6\frac{1}{2}$ - $4\frac{1}{2}$ lin., lat. $2\frac{1}{2}$ -2 lin.

The smallest species of *Pheropsophus* with which I am acquainted. Head and mouth testaceous, with the vertex and back part black, smooth in front, with a shallow depression on each side, faintly corrugated behind. Antennæ long, reaching to the middle of the elytra, fusco-testaceous, a little more dusky towards the tip. The upper side of the thorax is black, but sometimes a transverse testaceous blotch shows itself on each side of the thorax; it is smooth and impunctate, but some small depressions may be seen irregularly occurring along the

* Dejean's name *bimaculatus* has been changed by M. Reiche, as above noted, into *bisignatus*, on the ground that M'Leay had previously occupied the name in the allied genus *Planetes* by his species *Planetes bimaculatus*. But I think this is carrying the dread of a double employment of names to an excessive extent. *Planetes* is recognized as a good and distinct genus from either *Macrocheilus* or *Acanthogenius*, and a repetition of the same specific name in each does not seem to entail any great inconvenience—certainly none so great as that of changing a well-known and established name.

margins; it has a deep longitudinal mesial line, scarcely extending to the front or base, and deepest where it joins the curved line in front; some wrinkles run off transversely from it. Elytra with nine strong smooth shining longitudinal ribs (counting the sutural and marginal ones), the spaces between the ribs covered with short longitudinal strigæ; black, with a transverse irregular testaceous-yellow spot a little before the middle of each elytron; the spot varies in size and form; it has usually a tooth or sometimes two projecting behind, and a larger prominence projecting in front. There is also another small spot of the same colour on the shoulder, but this is sometimes absent; and in such cases the spot in the middle is exceedingly reduced in size, so much so, that I should not be surprised to find individuals with the elytra wholly free from spots; but I have never seen any such. The extreme apex of the elytra has a narrow edging of testaceous colour, which extends forwards a very little way on the ribs. Looking carelessly, it would appear as if it were the ribs which gave the slightly yellow tinge to the extremity of the elytra; but the extreme margin of the apex is itself testaceous. The portion of the upper side of the abdomen projecting beyond the elytra is deeply punctate, black, with a tracing of yellow round the margins of the segments. The under side of the head is testaceous yellow; of the thorax black, more or less encroached upon by testaceous yellow; usually there is a testaceous line along the middle, and another along each side next the edge, but sometimes almost the whole under side of the thorax is yellow. The mesosternum is yellow; the rest of the breast is black, with the exception of a portion of the sides. The legs, the trochanters, the joints, and parts from which they spring, are yellow; the thighs are all slightly tipped with fuscous, more or less dark. The segments of the abdomen are black, with the exception of the middle of the posterior margin of the first segment, which is yellow when exposed.

CALLEIDA, Dej.

1. *C. ruficollis*, Fab., Dej. 5. 185.

Thorace, pectore, ano, antennarum femorunique basi, tibiisque quatuor posticis rufis; elytris viridibus; capite, abdomine, antennis pedibusque nigricantibus.

Long. $4\frac{1}{2}$ lin., lat. $1\frac{1}{2}$ lin.

[To be continued.]

XIV.—*Researches on the Development of the Myriapoda.*
By M. FABRE*.

THE male and female sexual organs in the different genera of the Chilognatha exhibit anatomical peculiarities of which it is difficult to give a succinct account. In all the genera observed by M. Fabre (*Polydesmus*, *Iulus*, *Craspedosoma*, *Glomeris*, *Pollyxenus*) the vulvæ open at the base of the second pair of legs, or between this pair and the third; the orifices of the male organs also occur in the vicinity of the second pair of feet, or at their base. In *Pollyxenus* alone, the spermagenous canals open into two enormous penes, longer than the legs and of a greater diameter than the largest joint of these.

Fecundation takes place in the usual way in *Glomeris* and *Pollyxenus*, by the contact of the male and female organs. On the contrary, it is effected in a very singular manner in the *Polydesmi* and *Iuli*. The male possesses a copulative organ, which in *Polydesmus* is formed at the expense of the first pair of feet of the seventh segment. No communication exists between the spermagenous gland and this apparatus. The male seizes the female with his jaws at the back of the neck, then turns her over, and applies his belly to hers. In this position he passes her a little in front; his mouth is applied to the back of the neck of the female, whilst the latter seizes the throat of the male with her jaws. The copulative apparatus is then placed in front of the vulvæ, which receive it. The copulation lasts about a quarter of an hour. The male soon afterwards sets out in search of another female, and the female admits the advances of another male. By attentively observing a male just after he had quitted a first female, M. Fabre saw him elevate the anterior part of his body, and bending it into the form of an S, bring together the second and seventh segments, that is to say, bring his genital apertures in contact with his copulative apparatus. This manoeuvre, which exactly resembles what takes place in the *Ara-neida* and *Libellulæ*, is repeated after each copulation, and it is only after its accomplishment that the male begins his search for another female.

The Chilognatha present considerable differences as regards their development. M. Fabre has been unable to observe the eggs of *Polydesmus complanatus*, but he has found young not more than $\frac{1}{4}$ mill. in length, and furnished with only three pairs of feet. Each pair of feet was supported upon a different segment, and these legs corresponded with those which, in the adult, are also placed singly upon the first, third and fourth

* Abstract from the *Annales des Sciences Naturelles*, [4.] vol. iii. 1855.

segments, both in the male and female. With the progress of development the animal gradually acquires a greater number of segments and feet. The author has followed this progress up to the eighth stage, when the animal has acquired a length of 20 mill., and possesses twenty segments, not including the head; at this period we find thirty pairs of feet in the male and thirty-one in the female; and it is only then that the copulative organs make their appearance. From his observations he derives the following laws:—1. Each new segment appears between the anal and penultimate segments. 2. All the apodal segments in one stage become pedigerous in the next.

Some authors have asserted that the *Iuli* are produced in an apodal state, others that they are born hexapod. M. Fabre has been able to study the eggs of his *I. aterrimus*. Escaping from these he saw a singular body entirely destitute of any appendicular organs, and not presenting the least resemblance in form to the animal from which it was produced. This, which the author calls the *pupoid body* (*corps pupoïde*), is reniform, deeply excavated beneath, convex above, large and rounded at one of its extremities, a little narrowed and conical at the other; its surface is smooth, shining, and of a pure white; it exhibits no movements, even when pricked with a needle. Five days after its exclusion distinct traces of segmentation are seen in this body, and in the thickness of the inflated end the head begins to be perceptible, folded down upon the abdomen. Seven or eight days afterwards, it splits, and the young animal makes its appearance, with the characters attributed by De Geer and Gervais to the *Iulus* at the moment of its birth.

This young *Iulus*, when just excluded, is $1\frac{1}{2}$ mill. in length; it is completely white, formed of seven segments, not including the head, and furnished with three pairs of feet, which correspond with the first three pairs of the adult; the antennæ are composed of four joints. In proportion as the development takes place, the eyes, which at first were only one on each side, increase rapidly in number, and the older parts of the body acquire a deeper colour. The *Iulus aterrimus* is not completely adult and fit for reproduction before the end of two years; and the life of these animals must apparently be pretty long. M. Fabre has kept adults in captivity for two years.

In the Chilopoda, the ovigenous and spermatogenous organs, although complicated, present no remarkable anatomical arrangement. This is not the case with their products, which, in *Scolopendra*, *Cryptops* and *Geophilus*, are enclosed in capsules which M. Fabre thinks he may compare with the spermatophora of the Cephalopoda and of some Crustacea. In *Scolopendra* and *Cryptops* the spermatophora are formed in the most inflated portion

of the seminal canal (*canal vecteur du sperme*); their number is small, as there are usually less than seven of them. They are reniform; their external envelope is very thick, transparent and elastic; the internal envelope, which is very fine and loose, protrudes, in the form of a dull white nipple, through an orifice of the first envelope. In water this nipple becomes inflated, projects more and more, and at last bursts and gives issue to bundles of spermatozooids.

In the *Geophilii* "several of the spermatozooids are rolled together in a circular form, and superpose their different spiral turns so as to form a ring, or rather a short hollow cylinder of rolled cords. Each cylinder is then clothed with a protective coat formed of hyaline particles, slightly agglutinated. At the least contact this fugacious envelope breaks up into light flakes." No one has yet succeeded in seeing the copulation of the Chilopoda. M. Fabre has been no more fortunate in this respect than his predecessors, but he has observed some exceedingly curious facts which may explain the mode of fecundation in these animals. He says: "At the end of September, in examining some specimens of *Geophilus convolvens*, Fabre, which I had kept for some time in captivity, I observed in the passages formed by these animals in the mould which served for their abode, some very small nets, formed of arachnoid filaments, arranged at a great distance apart. Their woof was composed of a small number of threads stretched across from wall to wall of the passage, and irregularly crossed. Other similar nets appeared out of the mould, stretched between some stalks of moss with which I had completed the filling of the bottle. At the centre of each, far from contact with any solid body, was suspended a white spherical globule, of the size of a pin's head, which I took at first for an egg. Having detached one of these nets, I examined the globule with the microscope: its delicate envelope burst with the first contact. What was my astonishment at recognizing in this globule a little drop of semen, with its cylinders of spermatozooids in full gyration! Several others were collected, and the results were the same. Inexplicable as this exceptional case was, doubt was impossible: I had certainly the semen of the *Geophilus* before me. In two or three days these first globules had disappeared, either drying, or being destroyed by *Acari*, which appeared to be very fond of them. But new nets were already spread with their drop in the centre, and this continued for about six weeks; so that notwithstanding their rapid destruction, there were always five or six of them in the bottle. I observed the last on the 12th of November."

The *Geophilii*, and probably also the other Chilopoda, consequently deposit their spermatophora upon an arachnoid net-

work. But what becomes of them? and how do they arrive at the seminal receptacles of the females? Of this we still know nothing, and it is difficult to form any probable supposition; observation alone can settle the question.

M. Fabre has observed the phases of development in several genera of Chilopoda. *Lithobius forcipatus* is born with ten segments, seven pairs of feet, seven joints in the antennæ, and two ocelli. Two months afterwards, it has acquired its seventeen segments, its fifteen pairs of feet, twenty-six joints in its antennæ, and six ocelli on each side.

He has found the young of *Scutigera araneoides* furnished with only seven pairs of feet, and in all probability in the first stage of their development. This species not only presents an increase in the number of segments, legs, ocelli, and joints of the antennæ, but also in that of the joints of the tarsi. What is most singular in this development is, that the segments which bear the first seven pairs of feet, and which exist at the moment of birth, form the half of the body which contains the organs of the senses and the essential parts of the digestive apparatus; whilst the other half, which lodges the reproductive apparatus, is developed subsequently. It appears therefore that this anterior part represents the *larva*, which only manifests the life of the *individual*, and the posterior part the *perfect insect*, in which resides the life of the *species*. This distinction appears the more evident, as the dorsal shield of the median region is the largest of all, and differs so much from the others, that Linnæus called it the *elytron*: it covers three pairs of feet, of which the first two belong to the young animal at the time of its exclusion, and the third to the part of the body produced by gemmation. It thus, as M. Fabre says, marks the separation of the anterior portion of ovular origin, from the posterior portion of gemmary origin. M. Fabre from this compares the development of the *Scutigera* with the facts observed by Milne-Edwards and Quatrefages in *Syllis* and the *Myrianides*.

The development of *Cryptops* is especially interesting, because the parts of the mouth are deficient in the young. With the microscope nothing is seen but a rounded aperture, situated at the extremity of the head, and fringed at the margin. It is also to be observed, that as many as twenty-eight and twenty-nine joints are found in the antennæ of *Cryptops Savignyi*, which afterwards have only seventeen: the original number must diminish with age, either by amalgamation or by the casting of some of the joints.

BIBLIOGRAPHICAL NOTICES.

Elementary Course of Geology, Mineralogy, and Physical Geography. By Prof. D. T. ANSTED, M.A., F.R.S. &c. Second Edition. London, post 8vo, 1856, Van Voorst.

THE former edition of Prof. Ansted's *Elementary Course* was noticed in this Journal, and has been favourably received as a text-book. The present edition is very much improved, and may almost be regarded as a new work; for although the general divisional character of the earlier volume is retained, yet the rearrangement of the essential parts, the abstraction of comparatively useless and the insertion of much new useful matter, of a practical kind, and the bringing of the various divisions of the subject into somewhat better proportion, have considerably enhanced the value of the present Manual.

Geology may be considered under two different heads—its theoretical aspects and practical bearing: the one inquiring into the character, position, and arrangement of the various materials composing the earth's crust; the other applying the knowledge thus acquired to the practical purposes and economical relations of life. Independently of the interesting history revealed to us by Geology of the mutations which the earth's surface has undergone, and the remarkable forms of animal and vegetable life which have successively tenanted it, and were adapted to the varying physical conditions, the practical importance of the science has been realized and acknowledged; for it is based upon numerous observed facts respecting the position and occurrence of the different materials—facts too distinct, and too nearly connected, to admit of any fear that the legitimate conclusions that have been drawn from them can ever be shaken.

Prof. Ansted's work differs from the ordinary treatises on Geology, and this difference, to some extent, is a useful feature. Experienced geologists may object, that the author has treated too summarily subjects which ought to be and are the object of special works, and that they are too much condensed for a learner. To some extent this may be an objection; having, however, found the previous edition adapted to a certain class of readers and students, Prof. Ansted has adhered to the same general plan of including the elements of all departments of geological science, as well as bringing within a narrow compass a multitude of facts important to be known, arranged in a convenient and systematic order; but the author is perfectly aware "that these qualities are obtained at the sacrifice of a certain amount of popularity, and he can hardly hope to render very attractive to the general reader the accumulation of material which it has been his chief object not to dissipate."

The four divisions under which the contents are arranged, include Physical Geography, Mineralogy, Descriptive and Practical Geology: the subject-matter is nearly equally divided, with the exception of the Descriptive portion, which exceeds by about sixty pages each of the others. The first six chapters comprise the mechanical con-

dition and properties of the substances met with near the earth's surface,—the forces of attraction and repulsion, light, heat, electricity, and chemical affinity,—the general distribution and changes in the condition of matter at the surface,—the various effects produced by atmospheric, aqueous, and organic agencies,—the reaction of the interior upon the external surface, as in volcanic and earthquake phenomena. The chapters on Mineralogy contain the form, structure, physical characteristics of minerals, and their classification; the arrangement, which has been modified, is upon the basic plan; and the list includes with synonyms 1400 names: the more important minerals, and those most useful in geological investigation, are more fully described in the text. In alluding to the use of the blowpipe, it would have been more useful if the author had given a concise account of the discrimination and reaction of the chief metallic substances. The Descriptive part comprises an account of the nature, mode of original aggregation, and subsequent changes of the different kinds of rock, their structure and mechanical displacement, and the classification of them by means of fossils. In citing the laws of distribution of fossils, Prof. Ansted has omitted the reference to Pictet, which was properly referred to in the first edition; for as some of the points are open to controversy, it is but right that the authority for them should be given. At p. 307 is a table of the numerical proportion of genera in the various rocks of the British Isles, compiled from the last edition of Morris's 'Catalogue of British Fossils.' The paucity of the fauna mentioned under Older Silurian may be accounted for by stating that under this term are included merely the Lingula flags and beds called 'Cambrian' by some authors,—the equivalents of the primordial zone of Barrande in Bohemia, and of the alum-slates of Sweden. The generic distribution of fossil plants is omitted from this table, and is here given as reduced from the same work:—

Sil.	Dev.	Carb.	Perm.	Trias.	Ool.	Cret.	O.Tert.	N.Tert.
4	3	61	7	4	53	8	20	8

The chapters on the classification and distribution of the palæozoic, secondary and tertiary rocks and their fossils, follow; the description of these proceeds in a regular order from the older to the modern groups, an arrangement which has many advantages over that which recedes in the reverse or downward order, as adopted in the former edition. We are glad, therefore, that Prof. Ansted has thought it advisable to alter his former plan; for surely it is better for the student to trace upwards the successive phases in the history of the globe, each of which has been partly dependent on the preceding, than to commence with the existing order and travel backwards. The growth by which the civilization of our own period has been produced, would be less understood by a written history commencing with the present dynasty.

The fourth and concluding part is devoted to Practical Geology, the matter being very much increased, improved, and more complete than in the former edition. The subjects treated of are:—agricultural geology, drainage, water supply, earthy minerals used

in construction,—also the quarrying, streaming and mining in stratified deposits, for gold, tin, coal, iron, salt, &c., the distribution and mineral statistics of the three last-named being given; and coal-mining and coal are fully treated, both here and in a preceding section. The last chapter describes mining operations for those valuable substances contained in cracks or fissures in various rocks, as metallic veins, and which require methods somewhat different to those that occur in stratified beds. This portion has been considerably enlarged, the geological conditions under which mineral veins occur, as well as the mode of working, are explained, additional illustrations of machinery and sections of veins being given. A useful glossary of scientific and technical words in mineralogy and geology is appended, including the explanation of numerous mining terms. Much information is usefully presented in a tabular form, and the 250 illustrations of sections and fossils are generally good. As before stated, the subject-matter is more varied than is usually found in elementary manuals, but it is concisely treated and methodically arranged, so as to form a text-book for the student and a useful practical guide for the miner, engineer, and traveller; for the author has “endeavoured not merely to describe facts and quote the observations of field-geologists, but also to teach principles, leaving it to the reader to apply those principles and digest the facts, working out thus a sufficient education in the subject,” and moreover, “if he understands the nature of the materials of which the earth’s crust is made up, the order of their arrangement, and the changes undergone both in the rocks themselves and in the position they occupy, he will not be inclined to question either the value of such knowledge to practical men, or the nature of the applications of geology to practical purposes.”

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

March 11, 1856.—Dr. Gray, F.R.S., in the Chair.

OBSERVATIONS ON *STRONGYLUS FILARIA* AND *BOTAURUS STELLARIS*. BY EDWARDS CRISP, M.D.

Dr. Crisp exhibited specimens and drawings of *Strongylus filaria*, which he discovered had lately proved so destructive to lambs in many parts of England. In several lambs examined by Dr. Crisp, millions of these entozoa and their ova were found in the bronchial tubes and in the intestinal canal, and he believed that many of the ova of these worms had been mistaken for *Cysticerci*; but the various stages of development could be readily traced under the microscope. Dr. Crisp had tried many experiments on the living worms as to the effect of poisons and other agents, and he believed that salt or sulphur given with the food, and the inhalation of sul-

phurous gas, under proper superintendence, would be the most likely means of destroying these parasites.

Dr. Crisp also placed on the table some parts of the anatomy of the Common Bittern (*Botaurus stellaris*), two of which birds (now comparatively rare) had recently been shot on the eastern coast of Suffolk. The bird from which the specimens were taken was a fine male, measuring from the tip of each wing 4 feet 1 inch, and from the point of the beak (when extended) to the lower part of the tarsus 3 feet. Among the peculiarities alluded to, was the smallness of the sternum, which measured only 3 inches longitudinally; the depth of keel only $\frac{1}{2}$ of an inch, and the lateral margins the same. The trachea measured twelve inches in length, and consisted of 198 imperfect rings; the bronchi of 20 semicircular elastic cartilages, readily approximated, and hence the production of the peculiar sound from which the bird takes its name. The stomach which was exhibited was large, and contained near its cardiac orifice a circle of gastric glands. A roach, weighing about four ounces, was digested at this part, but the tail, which was in the œsophagus, was intact. To show the voracity and capacity of swallow of this bird, Dr. Crisp said, that Sir W. Jardine and Mr. Yarrell had both taken a Water Rail from the stomach and œsophagus, and in Mr. Yarrell's specimen there were six small fish in addition. The pectinated claw was also exhibited, Dr. Crisp believing that it served for the purpose of cleaning the beak and mouth of the bird.

April 8, 1856.—Dr. Gray, F.R.S., in the Chair.

ON DINORNIS (Part VII.): CONTAINING A DESCRIPTION OF THE BONES OF THE LEG AND FOOT OF THE DINORNIS ELEPHANTOPUS, Owen. By PROF. OWEN, F.R.S., V.P.Z.S., &c.

Mr. Walter Mantell having, on his recent return from New Zealand, provisionally deposited his very extensive collection of remains of Dinornithic and other birds in the British Museum, I have gladly acceded to the wishes of that successful and enterprising collector, and of my friend the able Keeper of the Mineralogical Department of the Museum, to devote the leisure at my command to the examination of this interesting and valuable collection.

I had advanced as far as the determination of the bones of the leg, and their classification according to their species, when the distinctive characters of one series of these bones irresistibly brought a conviction that they belonged to a species of *Dinornis* that had not previously come under my notice, and a species also which, for the massive strength of the limbs and the general proportions of breadth or bulk to height of body, must have been the most extraordinary of all the previously restored wingless birds of New Zealand, and unmatched, probably, by any known recent or extinct species of this class of birds.

I was so much struck by the form and proportions of the metatarsal bone described in the memoir read to the Zoological Society,

June 23, 1846, and figured in pl. 48, figs. 4 and 5, vol. iii. of the 'Zoological Transactions,' that I alluded to it as "representing the pachydermal type and proportions in the feathered class*," and the bone unquestionably indicated at that period "the strongest and most robust of birds." By the side of the metatarsus of the species which I have now to describe, and for which I propose the name of *elephantopus*, that of the *Dinornis crassus*, however, shrinks to moderate, if not slender dimensions. But the peculiarities of the elephant-footed *Dinornis* stand out still more conspicuously when the bones of its lower limbs are contrasted with those of the *Dinornis giganteus*.

I propose, in the present memoir, to combine with the account of the leg- and foot-bones of the *Dinornis elephantopus*, that of the bones of the lower limb of the *Dinornis crassus*, which had not previously been described, and to bring out their characteristics by comparison with the bones of other species, especially those of the *Dinornis robustus*.

Commencing with the femur, I shall premise the following table of admeasurements of that bone in *Dinornis* :—

Dimensions of the femur in	<i>D. robustus.</i>		<i>D. elephantopus.</i>		<i>D. crassus.</i>	
	In.	Lines.	In.	Lines.	In.	Lines.
Length	14	2	13	0	11	10
Transverse breadth of proximal end	6	0	5	10	4	5
Fore-and-aft breadth of do ...	5	0	4	5	3	9
Transverse breadth of distal end ...	6	0	5	11	4	7
Fore-and-aft breadth of do.....	4	3	3	9	3	5
Circumference, least, of shaft	7	10	7	9	6	0

The above comparative dimensions bring out the characteristic proportions of the femur of the *Dinornis elephantopus*, as shown by its greater thickness and strength. As compared with the femur of the *Dinornis robustus*, this character is remarkably exemplified on a comparison of their articular extremities. Had these parts alone of the *Dinornis elephantopus* been preserved and submitted to me, I should have scarcely ventured upon a conclusion as to their specific distinction from the *Dinornis giganteus* or *Dinornis robustus*, the correspondence of configuration being so close, and the difference of size so slight.

The articular surface is continued from the head upon the upper part of the neck, expanding as it approaches the great trochanter, along the summit of which it is terminated by a ridge. In both species the surface for attachment of the ligamentum teres is formed, as it were, by a portion of the inner and back part of the hemisphere having been cut off obliquely with a slight excavation. The corresponding ligamentous surface in the head of the femur of the *Dinornis crassus* is relatively smaller, less depressed and less defined. The upper and fore part of the trochanter is less produced relatively to the breadth of the supra-trochanterian articular surface in the *Dinornis elephantopus*. In this species the sub-circular rough surface for the attachment of the *iliacus internus* muscle is relatively

nearer to the head of the bone than in the *Dinornis robustus*; the rugged and thick fore part of the great trochanter descends lower upon the shaft; indeed, the shortness of the entire bone seems to depend chiefly on the shaft being relatively shorter in the *Dinornis elephantopus*. The intermuscular ridge continued from the trochanterian one seems to bifurcate sooner in the *Dinornis elephantopus*. The depression behind the trochanterian ridge is less deep in the *Dinornis elephantopus*. The oblique rotular channel is relatively as wide and deep as in the *Dinornis robustus*, but the inner boundary formed by the fore part of the inner condyle is shorter.

At the back part of the shaft the medullo arterial foramen is relatively nearer the proximal end of the bone; the two tuberosities below this are closer together. The two sides of the fibular groove are at a more open angle, and the groove is less deep in the *Dinornis elephantopus*, the outer side being less produced.

The antero-posterior breadth of the outer and inner condyles is equal in the *Dinornis elephantopus* as in the *Dinornis robustus*; but in the *Dinornis crassus* that dimension of the outer condyle exceeds the same dimension in the inner one, and the fibular groove is more open or shallow than in the *Dinornis elephantopus*.

The generic modifications of the femur are, however, very closely preserved in each species, being strictly of the type ascribed to the genus *Dinornis* in my original memoir, Zool. Trans. vol. iii. p. 247.

Dimensions of the tibia in ...	<i>D. robustus</i>			<i>D. elephantopus.</i>			<i>D. crassus.</i>		
	Ft.	In	Lines	Ft	In	Lines	Ft	In	Lines
Length	2	8	3	{ 2	0	0	1	7	6*
				{ 1	9	6*	1	6	6
Transverse breadth of proximal end	7	6		{ 7	5*		6	2	
				{ 7	0				
Fore-and-aft breadth of do.....	4	9		{ 4	6*		3	6	
				{ 4	3				
Least circumference of shaft.....	6	9		6	5		4	10	
Transverse breadth of distal end...	4	4		{ 4	2*		3	3	
				{ 4	0				

The characters of the upper end of the tibia of the *Dinornis elephantopus* closely accord with those of the *Dinornis robustus*, and the difference of size, as exemplified in the foregoing table, is so slight, that had this extremity only of the bone reached me, I should most probably have referred it to the *Dinornis robustus*. The almost flat articular surface for the inner condyle of the femur is somewhat less in its shorter diameter; the epicnemial ridge is less extended transversely; the ectocnemial ridge curves more strongly outwards; but there are individual varieties in all these characters in the tibiæ before me. All the tibiæ, however, differ in the earlier subsidence of the ridge continued downwards from the procnemial plate, which ridge is continued in *Dinornis robustus* uninterrupted by that above the inner division of the distal trochlea. The space between the ecto- and pro-cnemial plates in the *Dinornis crassus* is relatively greater than in either of the above larger species; the ridge con-

* The extremes of size in a series of several bones are here given.

tinued from the procnemial plate is interrupted as in the *Dinornis elephantopus*. The fore part of the tibia internal to the procnemial ridge is impressed by irregular vascular grooves. The fibular ridge is interrupted by a smooth tract, in or near which is the orifice of the canal for the obliquely descending medullary artery in all the species of *Dinornis*. The upper division of the ridge is shorter in the *Dinornis elephantopus* than in the *Dinornis robustus*, and relatively shorter than in the *Dinornis crassus*. The surface between the fibular ridge and the inner border of the shaft at the back part is concave transversely in *Dinornis elephantopus*, not merely flat as in *Dinornis robustus* and *Dinornis crassus*, and, as it descends, it continues longer a flat surface before it changes gradually to a convex one. The oblong rough insertional surface above the inner condyle is relatively shorter and better defined in the *Dinornis elephantopus* than in the *Dinornis robustus*. On the characteristic fore part of the lower end of the tibia, that bone in the *Dinornis elephantopus* repeats all the modifications ascribed to the *Dinornis* in my memoir on the *Gastornis*, or large fossil bird from the Paris eocene*.

The tendinal canal inclines obliquely inwards parallel with the inner border of the expanding end, near which it is placed; the bony bridge spans across it from a flattened tubercle developed from the lower part of the outer pier. The outlet of the canal is as wide as in the *Dinornis robustus*; its aspect is obliquely forwards and downwards. External to the tubercle is an oblique rough depression, relatively narrower and better defined than in the *Dinornis robustus*. The inner condyle is relatively narrower and more produced forwards than in the *Dinornis robustus*, resembling more the proportions of that part in the *Dinornis crassus*. The general form and oblique direction of the wide distal trochlear articulation are closely repeated in all the species, the canal being rather more sharply defined behind in the *Dinornis elephantopus* than in the *Dinornis robustus*. The depression on the entocondyloid surface is less deep in the *Dinornis elephantopus* than in the *Dinornis robustus*.

The above-specified differences, as well as all that I have noticed in the tibiae of other species of *Dinornis*, are so inferior in degree to those which I have found in closely allied genera, and even in different species of the same genus, of other large land- and wading-birds, as *e. g.* in species of *Ciconia*, and in the existing *Struthion* genera, as to leave a strong impression on my mind of the generic affinity of the species which I have referred to *Dinornis* and *Palapteryx*, and which species have been divided, with a more liberal imposition of terms, by Dr. Reichenbach into the nominal genera *Anomalopteryx*, *Motia*, *Emeus*, *Syornis*, &c., no additional facts or characters being given by that nomenclator than are to be found in the pages or plates of my own memoirs.

The fibula of the *Dinornis elephantopus* remains, as in other *Dinornithes*, and as in the existing *Struthion* genera, permanently distinct from the tibia; as a general rule in birds, it soon becomes ankylosed to that bone. In the species now defined it is a straight

* 'Proceedings of the Geological Society.'

styliform bone, 14 inches 6 lines in length. The head is subcompressed and produced, as if slightly bent backwards; the upper articular surface is convex from before backwards, almost flat transversely. The head of the bone is flattened on the inner side, almost flat, but a little convex on the outer side. The fore-and-aft dimension is 2 inches 9 lines, the transverse diameter 1 inch 3 lines. Below the head the bone assumes a trihedral form, with the sides convex, gradually tapering, and blending into a shape elliptic in transverse section, and ending in a point about 9 inches above the ankle-joint. The outer surface of the shaft of the fibula is impressed by two oblong rough surfaces for the insertion of muscles, the upper one 2 inches 9 lines in length; the inner part, which is ridge-like, dividing the fore from the back surface of the bone, presents a rough surface with a median interruption, for the ligamentous attachment to the fibular ridge of the tibia.

Dimensions of the Metatars of.....	<i>D. giganteus.</i>		<i>D. robustus.</i>		<i>D. elephantopus</i>		<i>D. crassus</i>	
	In.	Lines	In.	Lines	In.	Lines	In.	Lines
Length	18	6	15	9	9	3	8	8
Transverse breadth of proximal end ...	4	3	4	6	4	5	3	3
Transverse breadth of distal end.....	5	4	5	3	5	4	3	9
Least breadth of shaft.....	2	3	2	0	2	5	1	9
Fore-and-aft breadth of proximal end...	3	2	3	2	2	10	2	5
Circumference of ditto.....	12	0	12	9	12	0	9	3
Least circumference of shaft	6	3	5	3	6	6	4	6
Breadth of middle trochlea.....	1	10	2	3	2	2	1	8
Length of do. following the curve	5	9	5	4	5	3	4	0

I had hitherto regarded the metatars of the *Dinornis crassus* (Zoological Transactions, vol. iii. pl. 48, figs. 4 and 5) as presenting the most extraordinary form and proportions of all the restored species of huge wingless birds of New Zealand; but it is strikingly surpassed in robustness and in great relative breadth and thickness by the same bone of the present species, which chiefly on that account I have proposed to name *elephantopus*. Only in the great Maccaws and Penguins do I know of a metatars with similar proportions to that of this most robust-legged of birds. But the Parrot tribe present those peculiar modifications of the distal trochlea, with the strong articulation for the back toe, which relate to the scansorial modifications of the bird's foot; and the Penguins associate with their broad and short metatars a characteristic retention of much of the primitive separation of the three constituent bones. In the *Dinornis elephantopus* these elements have become as completely coalesced as in any other species, and the general characters of both proximal and distal ends accord with those in previously described species. On a more special comparison of the metatars of the *Dinornis elephantopus* with that of its nearest congener, the *Dinornis crassus*, the following differences present themselves:—The endocondyloid depression is deeper, its fore-and-aft diameter is greater, and its transverse diameter less, than in the ectocondyloid one; but the breadth of the endocondyloid depression is relatively greater, and its depth somewhat less in the *Dinornis elephantopus* than in the

Dinornis crassus. The transverse convexity dividing the two condyloid depressions is relatively broader in the *Dinornis elephantopus*; and the rough surface external to the anterior intercondyloid prominence is more strongly marked. The two calcaneal ridges present an equal prominence in *Dinornis elephantopus*; the ectocalcaneal one is the more prominent in *Dinornis crassus*. The anterior surface of the metatarsal differs chiefly in the proportions indicated in the table of admeasurements from that in the *Dinornis crassus*; like most of the metatarses of that species, one or more vascular foramina occur above the subcircular rough surface of insertion of the *flexor pedis*, which occupies the lower part of the shallow depression in the upper and fore part of the shaft. Along the lower half of the shaft, the median longitudinal, and progressively widening prominence, due to the middle of the coalesced metatarsal bones, is rather more marked than in *Dinornis crassus*. The inner side of the shaft is marked at its upper half by the oblique rough tract indicative of the insertion of the powerful aponeurosis of the gastrocnemii muscles. At the back surface the upper part of the middle metatarsal is relatively less prominent than in *Dinornis crassus*. The two vascular foramina occupy corresponding relative positions. All other notable differences are those of size and proportion.

From the metatarsal of the *Dinornis robustus* that of the *Dinornis elephantopus* differs most strikingly in its proportions of length to breadth, being little more than half the length, but of nearly equal breadth; the distant trochleæ, however, being relatively less expanded than in the *Dinornis robustus*.

The anterior vascular perforation is less than in the *Dinornis robustus*; the insertional roughness for the *tibialis anticus* below the foramen is of equal size. The upper half of the fore part of the metatarsal of the *Dinornis robustus* is longitudinally channelled in the *Dinornis robustus*, not in the *Dinornis elephantopus*. The corresponding part of the back part of the shaft is much more prominent in the *Dinornis robustus*. The characteristics of the metatarsal of the *Dinornis elephantopus* are more strongly manifested in the comparison with that of the *Dinornis giganteus*, of which bone it has only half the length, other dimensions being equal or even greater.

Of the depression, which is very faint, in the *Dinornis robustus* for the ligamentous attachment of the rudimental back toe there is no trace in the metatarsal of the *D. elephantopus*.

The bones of the foot I shall compare with those of the *Dinornis robustus**, to which they make the nearest approach in size. Equaling, or nearly equalling, the phalanges of that bird in breadth and thickness, they differ chiefly in shortness, but in a less degree than the metatarsi differ. These proportional characters of the species are best and easiest given in the plates. A few minor differences, however, may be noticed: the outer portion of the proximal end of the first phalanx of the inner toe is broader in proportion to its fore-and-aft diameter in *Dinornis elephantopus*. The inner portion of the

* See Trans. Zool. Soc. vol. iv. pl. 1.

proximal end of the first phalanx of the outer toe presents the like difference: the general form of that articular surface is less triangular and more oval in both the specified phalanges of the *Dinornis elephantopus*, one, the under side, being indented as usual in the proximal phalanges of the inner and outer toes.

The modifications in the other phalanges, besides those of size and proportion, are not greater or other than might be expected in different species of the same genus.

The first evidence of the *Dinornis crassus* reached me from a turbary deposit at Waikawaite, in the Middle Island; it formed part of the collection made there by Mr. Earl. I have never received any evidence of the species from the North Island.

In like manner the bones of the much larger bird, which I have called *Dinornis robustus*, and which I was formerly inclined to regard as a variety of the *Dinornis giganteus*, appear to be peculiar to the Middle Island; or at least have not hitherto been found in any locality of the North Island.

The richer series of illustrations of both the *Dinornis robustus* and *Dinornis crassus* in the collection of Mr. Walter Mantell are from localities in the Middle Island; and the abundant illustrations of the *Dinornis elephantopus* are exclusively from one locality in that island; they were obtained at Ruamoā, three miles south of Oamaru Point, or that called the 'Vast Rocky Head' in the new Admiralty map. This fact might give rise to the idea that the original range or locality of the *Dinornis elephantopus* had been a restricted one, unless, at the period when the species flourished, the geographical extent of the Middle Island was widely different from what it now is. Yet Mr. W. Mantell has obtained strong, if not unequivocal evidence, that the *Dinornis elephantopus* and *Dinornis crassus* existed contemporaneously with Maori natives. The bones described in the foregoing pages are in a recent and most perfect condition. They retain the usual proportion of animal matter and have undergone no mineral change.

From the sum of our present information respecting the localities of the several species of *Dinornithidæ*, we may infer that most, if not all, the species of the North Island were distinct from those of the South Island. To birds that could neither fly nor swim—at least swim well,—the channel called Cook's Straits would prove an effectual bar to any migration from one island to another. With each successive addition of materials for a complete history of this most remarkable family of birds, I feel, however, chiefly impressed with the conviction of how little comparatively we still know respecting them, and how much more is likely, through the enlightened co-operation of active, resolute, and accomplished explorers, like Mr. Walter Mantell, to be, hereafter, contributed towards a perfect history of the New Zealand wingless birds.

Of the very remarkable species of *Dinornis* based upon the powerfully developed limbs, the bones of which are described in the foregoing pages, Mr. Mantell's collection includes right and left femora, right and left tibiæ, right and left fibulæ, right and left

metatarsi, and a considerable collection of toe-bones, from which, probably, other entire feet might be reconstructed, in addition to the one of the left foot now submitted to the Society. There are also the two femora and the two metatarsi of an immature bird, apparently, by their proportions, from one individual, to which may also belong the proximal end of a tibia, wanting the articular epiphysis. The femora, as in the other birds, retain the two articular ends, which are simply rougher than in the adult, having been covered by a thicker cartilage, but are not developed upon distinct osseous pieces, as in land mammals. The proximal epiphysis is wanting in both the immature metatarsi, exhibiting the separate expanded ends of the three constituent bones terminating in the three prominent trochleæ below. The length of the femur of this young bird is 11 inches, that of the metatarsæ $7\frac{1}{2}$ inches. They already present the characteristic robustness of the adult bird*.

April 22, 1856.—Dr. Gray, F.R.S., in the Chair.

ON TWO NEW SPECIES OF BIRDS (*NESTOR NOTABILIS* AND *SPATULA VARIEGATA*) FROM THE COLLECTION OF WALTER MANTELL, ESQ. BY JOHN GOULD, F.R.S.

Mr. Gould brought before the notice of the Meeting two species of birds from the New Zealand group of islands which he conceived to be new to science; one, a magnificent Parrot, pertaining to the genus *Nestor*; the other, an equally interesting species of Duck, belonging to the genus *Spatula*. Both these birds had been placed in his hands for the purpose of describing, by Walter Mantell, Esq.

The *Nestor*, which is called "*Keá*" by the natives, is by far the largest of the three species of the form now known, and is certainly one of the most interesting of the ornithological novelties lately discovered. It not only differs from its near allies *N. hypopolius* and *N. productus* in its greater size, but in the greater uniformity of its colouring, in the yellow toothed markings of the inner webs of the primaries and secondaries, and in the orange toothed markings of the inner webs of the tail-feathers; the yellow colouring of the under mandible is another of the peculiarities by which it may be distinguished.

Mr. Mantell informed Mr. Gould that he first heard of the existence of the *Keá* about eight years ago from some old natives whom he was questioning as to the birds of the Middle Island. They said the *Keá* somewhat resembled the *Káka* (*Nestor hypopolius*), but that, unlike that bird, it was green, and added, that it used formerly to come to the coast in severe winters, but that they had not seen it lately. Mr. Mantell has only obtained the two specimens exhibited of this fine bird; they were shot in the Murihiku country, and for one of them he was indebted to Mr. John Lemon of Murihiku.

The following is a description of this new species, for which Mr. Gould proposes the name of

* This paper will appear in the Transactions of the Society, illustrated with figures of the bones.

NESTOR NOTABILIS.

General hue olive-green; each feather tipped in a crescentic form with brown, and having a fine line of the same colour down the shaft; feathers of the lower part of the back and the upper tail-coverts washed near the tip with fiery orange-red; primaries brown, margined at the base with greenish-blue; tail dull green; inner webs of the lateral feathers brown, toothed on their basal two-thirds with orange-yellow; all the tail-feathers crossed near the extremity with an indistinct band of brown, and tipped with olive-brown; feathers of the axillæ fine scarlet; under wing-coverts scarlet tipped with brown, the greater ones banded with brown and with yellow stained with scarlet; basal portion of the primaries and secondaries largely toothed with fine yellow, which is not perceptible on the upper surface unless the wings are very widely spread; upper mandible dark horn colour; under mandible yellow, becoming richer towards the point; feet nearly yellowish-olive.

Total length, 18 inches; bill, $2\frac{1}{2}$; wing, $12\frac{1}{2}$; tail, $7\frac{1}{2}$; tarsi, $1\frac{1}{2}$.

Hab. The Middle Island, New Zealand.

The Shoveller forms the fifth species known of the genus *Spatula*, and is distinguished from the other members by the dark crescentic markings which decorate the feathers of the breast, sides of the neck and scapularies. The species of this well-defined form previously described are *Spatula clypeata*, which inhabits Europe, North America, India and China; *S. rhynchotis*, which is found throughout Australia; *S. maculata*, the habitat of which is Chili, and probably the neighbouring countries of Peru and Bolivia; and *S. capensis* of South Africa. For the fifth, or New Zealand species, Mr. Gould proposes the name of

SPATULA VARIEGATA.

Crown of the head and space surrounding the base of the bill brownish-black; on either side of the face between the bill and the eye a lunar-shaped streak of white, bounded posteriorly with speckles of black; cheeks, sides and back of the neck dark grey with greenish reflexions; front of the neck dark brown, each feather narrowly fringed with white; back brownish-black, the feathers of the upper part margined with greyish-brown; feathers of the breast, sides of lower part of the neck, the mantle and scapularies white, with a crescent of blackish-brown near the tip; under surface dark chestnut blotched with black; flanks lighter chestnut barred with black; lesser wing-coverts dull greenish-blue; greater wing-coverts dark brown, fringed at the tip with white; first elongated scapularies blue-grey, with a conspicuous line of white on the outer web next the shaft, bounded posteriorly with black; the next blue-grey, margined on the inner web with white; the remainder greenish-black, with a lengthened lanceolate mark of dull or brownish-white down the centre of the apical half; speculum deep green; primaries dark brown with lighter shafts; under surface of the shoulder white; on each side of the vent a patch of white freckled with black; under tail-coverts black, tinged with shining green; tail dark brown; irides bright

yellow; bill dark purplish-black, the under mandible clouded with yellow; legs and feet yellow.

Total length, $16\frac{1}{2}$ inches; bill, 3; wing, $9\frac{1}{2}$; tail, $4\frac{1}{2}$; tarsi, $1\frac{1}{2}$.

Hab. New Zealand.

Remark.—This is by far the handsomest species of the genus.

DESCRIPTIONS OF TWO NEW SPECIES OF TRUE CUCKOOS
(GENUS CUCULUS AS RESTRICTED).

By JOHN GOULD, F.R.S.

CUCULUS STRENUUS, Gould.

Crown of the head, back of the neck, cheeks and chin dark grey; all the upper surface, including the upper tail-coverts, olive-brown, with shining purplish reflexions; tail olive-brown, crossed by four bands of darker brown, and tipped with buffy white; throat white, passing into the chestnut, which forms a band across the lower part of the chest, each feather also has a double mark of black and chestnut down the centre; breast and upper part of the abdomen white, crossed by semicrescentic bands of very dark brown bordered with pale chestnut-red; edge of the shoulder, lower part of the abdomen, vent and under tail-coverts white; upper mandible olive; lower mandible yellow; irides and feet rich yellow.

Total length, $15\frac{1}{2}$ inches; bill, $1\frac{1}{2}$; wing, $9\frac{1}{2}$; tail, 9.

Hab. Manilla.

Remark.—In outward appearance this species so nearly resembles the *Cuculus sparverioides*, that one description would nearly serve for both; but in size it so far exceeds that bird, as well as every other true Cuckoo I have yet seen, that I have no doubt of its being distinct, and I have therefore assigned it a separate specific appellation, and have selected the term *strenuus*, as indicative of its great size and strength.

The specimen from which the above description was taken now forms part of the collection at the British Museum.

CUCULUS HYPERYTHRUS, Gould.

Crown of the head, all the upper surface and wings dark slate-grey; spurious wings white; lores, ear-coverts, moustache, and a spot on the chin black; throat white, with a fine line of brown down the shaft of each feather; under surface dull rusty-red; tail grey, crossed by two narrow irregular bands of black bordered with brown, and by a very broad band of black near the extremity, the tip being reddish-brown; upper mandible black; lower mandible and feet yellow.

Total length, $11\frac{1}{2}$ inches; bill, $1\frac{1}{2}$; wing, 8; tail, $6\frac{1}{2}$.

Hab. China.

Remark.—In size this species is rather less than the *Cuculus canorus* of Europe, and is altogether less elegant in its general contour. The rufous colouring of the breast and under surface, and the black marks on the cheeks and throat, characters seldom seen among the *Cuculidae*, are the features by which it may be distinguished.

The specimen described, like the preceding, is deposited in the National Collection.

3. NOTE ON BUGLODYTES ALBICILIUS, Bp.

BY PHILIP LUTLEY SCLATER.

Prince Bonaparte, in his "*Notes Ornithologiques sur les collections rapportées par M. A. Delattre*," read before the French Academy in 1853, has instituted a new genus, *Buglodytes*, allied to *Campylorhynchus*, Spix, and described but one species as belonging to it under the title of *B. albicilius*.

Having had an opportunity of examining this type (which is now in the British Museum), I have to state, that I believe it to be the same bird that was long ago named by Mr. Swainson "*Furnarius griseus*," and the type of Cabanis' genus *Heleodytes*. It has, however, nothing to do with *Furnarius*, and seems, as Prince Bonaparte has remarked, intermediate between *Campylorhynchus* and *Donacobius*. These forms appear to connect the American *Mimina* very closely with the Wrens, and to render the position of the former group among the true Thrushes rather doubtful. The synonymy of *Buglodytes albicilius* will stand as follows:—

Furnarius griseus, Sw. An. in Men. p. 325.

Campylorhynchus griseus, Schomb. Reise in Brit. Guian. iii. p. 674.

Heleodytes griseus, Cab. Mus. Hein. p. 80; G. R. Gray, List of Gen. and Subgen. p. 26, no. 401.

Buglodytes albicilius, Bp. Notes Orn. p. 26; G. R. Gray, List of Gen. and Subgen. p. 32, no. 499.

My specimen of this bird is from Trinidad. Schomburgk's were collected in British Guiana. The examples upon which the name *Buglodytes albicilius* was founded were obtained by MM. Verreaux's collector in the vicinity of Santa Martha, on the north coast of New Grenada.

From Trinidad also I possess a bird which seems to be the *Heleodytes minor* of Cabanis. It is so similar to *Heleodytes griseus* in every respect except in size, that I question whether it may not be a variety of age or sex of that species.

ON SOME NEW OR IMPERFECTLY-KNOWN SPECIES OF
SYNALLAXIS. BY PHILIP LUTLEY SCLATER.

1. SYNALLAXIS RUFICAPILLA.

Synallaxis ruficapilla, Vieill. N. D. d'H N. xxxii. p. 810; Enc. Méth. p. 622; Gal. Ois. pl. 174.

Sphenura ruficeps, Licht. Doubl. p. 42.

Synallaxis cinereus, Max. Beitr. iii. 685.

Synallaxis olivascens, Eyton, Cont. Orn. 1851, p. 150.

Olivascenti-brunnea, pileo toto cum nucha, alis extus et cauda rufis: striga superciliari flavida: loris et regione auriculari nigricanti-cinereis: subtus albicanti-cinerea, hypochondriis et erisaeo brunnescentibus, ventre medio albicantiore cinereo.

Long. tota 6·0, alae 2·1, caudæ 3·0.

Hab. Brasil.

2. *SYNALLAXIS SPIXI*, sp. nov.

Parulus ruficeps, Spix, Av. Bras. i. pl. 86, p. 85 (♂).

Synallaxis ruficapilla, Reich. Handb. d. Sp. Orn. p. 158.

Supra olivaceo-brunnea, pileo et alis extus rufis, cauda dorso concolore sed minus olivascens: capitis lateribus et corpore subtus cinereis: gutturi pennis intus nigris, extus argentescenti-albis: ventre medio albo: lateribus et crasso brunnescente tinctis.

Long. tota 6·5, alæ 2·1, caudæ 3·5.

Hab. Brazil.

These two *Synallaxes*, which appear to me to be very distinct birds, have always hitherto been confounded together. Specimens of *S. Spixi* are rather the most abundant in collections, and are usually marked *ruficapilla* or *ruficeps*, names both originally applied to the former species.

The *S. Spixi* may be distinguished by its brown tail, nearly the same colour as the back, not rufous like the head, as is the case in *S. ruficapilla*; by having no traces of yellowish supercilia, the whole sides of the head being uniform grey like the breast, and by its smaller and shorter bill, and longer, narrower and more pointed tail-feathers. The throat-feathers are black, finely edged with silvery white, which gives an appearance of a black patch on the throat when the plumage is slightly raised. In *S. ruficapilla* the throat and breast are uniform cineraceous white, and there is more olive-brown on the flanks than in the other species.

Another bird, very closely allied to these two, is *S. elegans*, which I have lately described, from Bogota. *S. pallida*, Max., is also very similar to *S. ruficapilla*, but has conspicuous white supercilia, and the under parts pale brown. *S. albens*, Temminck, (which has been also united to *S. ruficapilla* by Prince Bonaparte and other writers) is likewise different, and more closely resembles *S. Spixi*, from which, however, it is to be distinguished by having only the back part of the head rufous. A sixth nearly allied species is the Bolivian *S. Asaræ*, d'Orb.

3. *SYNALLAXIS CANICEPS*, sp. nov.

S. dorso, alis caudaque cinnamomeo-rufis: capite toto cervicæque grisescentibus, pileo albescentiore: subtus lactescenti-alba: rostro et pedibus pallidis: remigibus intus nigris: rostro elongato, parum incurvo, flavicante: pedibus pallide brunneis.

Long. tota 5·5, alæ 2·3, caudæ 2·1.

Hab. Brazil.

Mr. Eyton was obliging enough to send me his specimens of *Synallaxes* for examination a short time since, and most liberally offered to allow me to describe any I might think new. A single example of the present species which was in the collection seems different from any previously named. I have therefore taken advantage of Mr. Eyton's kindness to give characters to it under the specific title of *S. caniceps*. There is no other member of the genus

that I am acquainted with that much resembles it in colouring. The rectrices are ten in number.

Mr. Eyton's *S. modesta*, described in 'Contributions to Ornithology' (1851, p. 159), of which the types are in his collection, is one of a small group of species from Bolivia, Chili and Patagonia, consisting of *S. auvicularis*, Gould, *S. sordida*, Less. and *S. brunnea*, Gould; but I am doubtful whether all the four are really specifically distinct.

Professor Reichenbach, in his '*Handbuch der Speciellen Ornithologie*,' has chopped up the genus *Synallaxis* into seven or eight different sections. Some of these ought no doubt to be adopted, but the Professor has unfortunately referred some of the most closely allied species to different sections, and I think it better therefore to continue the employment of the old name for the whole of them, until a more accurate revision and arrangement of the whole of the species can be made.

ON THE POSITION OF THE GENUS PROSERPINA IN THE SYSTEM, AND A DESCRIPTION OF ITS DENTITION.

BY DR. J. E. GRAY, F.R.S., P.B.S., ETC.

In the Synopsis of the British Museum for 1840 (p. 129), I mention amongst the genera of *Helicidae* which have a thin edge to the mouth of the shell, a genus named *Proserpina*. It is peculiar amongst land shells for having a series of laminæ revolving in the throat, and the outer surface of the shell polished. This genus has been adopted by Sowerby, Pfeiffer, Jonas, and most other authors.

M. Duclos referred the species to the genus *Carocolia*; Adams, Pfeiffer, and Jonas in some of their earlier works considered them as species of the extended genus *Helix*.

M. d'Orbigny in his work on the Mollusca of Cuba, renamed the genus *Odostoma*, and referred it with doubt to the family *Cyclostomidae*.

Though the shell is far from uncommon in the West Indies, Cuba, and some parts of the American continent, the animal escaped the researches of Guilding, Adams, Chitty, d'Orbigny and other observers. In 1854, when in Berne, my friend, Dr. Shuttleworth, informed me that it had two subulate tentacles, with the eyes sessile on the outer side of their base; and Mr. Bland has mentioned that the animal has no operculum, and absorbs the septa between the upper whorls of the spire, like some species of the genera *Neritina*, *Auricula*, *Helicina*, *Stomastoma*, and a few *Helices*.

These observations induced me to place the family in my most modern arrangement near *Oligyradæ*.

Mr. Cuming has kindly brought to me a specimen of the genus, with its animal, which M. Sallé discovered under leaves in the mountains of Mexico, at some distance from the sea.

The species is allied to *Proserpina solina*, but differs in the spire being much more convex; I hence propose to call it *P. Salléana*.

Like *P. colina*, it differs from all the others I am acquainted with in the upper surface of the whorls being rugose, and only smooth on the lower surface, as is the case with many *Naninae*, showing, if the smoothness and polish of the surface depend on the extension of the mantle of the animal, that the extension in this kind is confined to the under surface of the shell, as is proved by the examination of the animal itself.

This being the case, I am inclined to form this shell and *P. colina* into a new genus under the name of *Ceres*, characterized by the roughness of the upper surface and the non-dilatation of the front edge of the mantle, which is believed to be dilated in all the other species of the true *Proserpinae*.

It will be seen that most authors have placed these Mollusca either with *Helices* or *Oligyræ*, and I was much inclined to follow their example, even after a cursory examination of the animal itself. It has much the external appearance of the animals of the latter family, having a short, broad, annulated muzzle with a triangular mouth, two subulate lateral tentacles, with the eyes sessile on the outer side of their base; a moderately short foot, truncated in front, acute and keeled above and behind, without any appearance of beards or any membranous ridge on the sides; the shell is slightly sunk into a cavity in the front of the upper keeled part of the foot, as if it possessed an operculum; the edge of the mantle is free from the back of the neck, producing an open nuchal respiratory cavity like *Cyclostoma* and *Oligyra*, and other operculated and unisexual land shells.

When the animal is more closely examined, it is found that there is no operculum; the concavity on the front part of the foot into which the under surface of the shell fits is furnished with a continuation of the mantle, having a raised crumpled edge evidently capable of being expanded over the under surface of the shell, and explaining the polished surface of this part of the shell;—a structure I have not observed in any other Mollusca. This extension of the mantle might be mistaken for the mantle of the operculum, which, as far as I know, is always quite distinct and separate from the mantle of the shell, but in this animal the fringed edge of the concavity is in direct continuity with the true or shell-forming mantle, both at the columnar and the outer external angle of the mouth of the shell.

The teeth of the lingual membrane are unlike those of *Cyclostoma* and *Helicina*, which agree with those of *Littorina* and other marine *Rostriferous* univalves. The teeth resemble those of the typical *Raphidoglossa*, as in the families *Neritinae*, *Turbonidae*, *Trochidae*, *Rafinesquinae*, &c. All the Mollusca hitherto known belonging to these families are aquatic, and all but the genera *Neritina* and *Navicellus* are truly marine. They all have well-developed gills, and the greater part have a more or less developed lateral membrane on each side of the body, furnished with three or more beards on its lower surface, and almost all have the eyes placed on a more or less distinct peduncle at the outer side of the base of the tentacles, all characters

absent in *Proserpina*. But notwithstanding all these peculiarities, I am inclined to arrange the family *Proserpinidae* (including *Proserpina* and *Ceres*) in the order *Scutibranchia*, section *Raphidoglossa*, and to form a suborder for it under the name of *Pseudobranchia*, in the same manner as the families *Cyclophoridae* and *Helicinidae* form the suborder *Phaneropneumona* of the order *Rostrifera*.

It may be thus characterized:—

Pseudobranchia. Gills vascular, branched on the inner surface of the mantle; body and shell spiral; eyes sessile; operculum none.

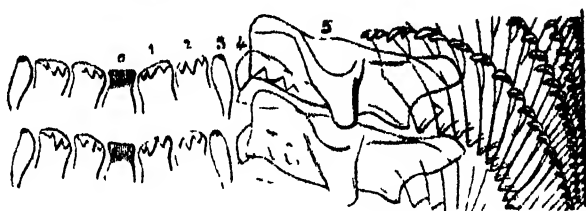
The open respiratory cavity, the separate sexes and the form of the teeth, preclude its being arranged with the *Pulmonobranchiata*, with which it has been hitherto placed on account of its terrestrial mode of life; but as our knowledge of the structure of Mollusca extends, it is found that some *Pulmonobranchiata* are marine, as *Siphonariadae* and *Amphibolidae*, in the same manner as the terrestrial *Cyclophoridae* and *Oligyridae* are properly arranged with the marine and fluviatile *Rostrifera*. The *Proserpinidae* might be arranged with the latter families, as was proposed before the teeth were known; but there can be little doubt that the animals which have the very numerous rows of such peculiar-formed teeth as the *Raphidoglossa*, must have very different habits and modes of life from those which have only seven rows of nearly uniform teeth, as the *Tenioglossa* or Rostriferous Mollusca.

And though the animal of the *Proserpinidae* differs from the more typical *Raphidoglossa*, yet all the peculiarities, except the vascular organs of respiration and terrestrial mode of life, are found in some of the genera of the suborder. Thus the eyes of *Fissurella* are sessile on the outer side of the base of the tentacle; the whole family of *Neritinae* and some of the genera of *Fissurellidae* are destitute of any lateral fringe or beards; so that though these organs are the usual characteristic of these animals, their absence is no proof that the family does not belong to the group, especially when we consider that the teeth have all the peculiarities, indeed, are perfectly typical in form with this well-marked and very peculiar tribe, and very probably it may prove that many terrestrial Mollusca may properly belong to the order.

The lingual membrane elongate, broad, with numerous longitudinal series of close-set teeth; the central teeth in 11 longitudinal series, 5. 1. 5, the two outer teeth on each side being large and irregular; the lateral teeth are numerous, crowded, compressed, linear, nearly equal, transparent, with recurved tip.

In *Ceres Salliana* the lingual membrane is broad, elongate, with close-set teeth. Teeth .00. 5. 1. 5. 00, in numerous longitudinal series; the central tooth is oblong, with a smooth recurved tip, the 1st and 2nd lateral teeth rather broader than the central, with three-toothed recurved tip, the 3rd narrow, elongate, with a slight recurved end, the 4th and 5th much larger, oblong and irregular shaped, the 4th about half the width of the 5th, with 3 or 4 denticles on the inner side of the upper edge; the 5th very large, broad, with a large subcentral reflexed lobe; the lateral teeth are very numerous,

subequal, compressed, transparent, with a recurved tip, which in the inner teeth of the series is bifid.



Teeth of *Ceres Salleana*.

1. *CERES SALLEANA*, Gray.

Shell yellow; upper surface conical, convex, rugulose, with numerous close, parallel, granular concentric striæ; lower surface smooth, polished; keel acute, expanded.

Hab. Cordera, State of Vera Cruz, Mexico, in dense woods, under dead leaves (*M. A. Sallé*).

2. *CERES EOLINA*. *Proserpina eolina*, Duclos, Mag. Zool.

The shell orange; upper surface flat, rugulose, with numerous short, parallel, diverging, narrow, sharp ridges; keel very acute, bent up; lower surface convex, subhemispherical, polished, orange; axial callosity thin, semitransparent, whitish.

GEOLOGICAL SOCIETY.

January 7, 1857.—Colonel Portlock, R.E., President, in the Chair.

The following communications were read:—

1. "On the *Dichodon cuspidatus*." By Professor Owen, F.R.S., F.G.S.

In this paper additional facts were communicated relative to the dentition of the *Dichodon cuspidatus* to those given in the author's original memoir on the species in the 'Quarterly Journal of the Geological Society,' vol. iv. p. 36. They related to the structure of the last molar tooth of the lower jaw, which has a third bicuspid lobe, and to the forms and period of succession of the permanent teeth. The formula of the deciduous dentition was

$$i \frac{2-3}{2-3}, c \frac{1-1}{1-1}, d m \frac{4-4}{4-4} = 32;$$

that of the permanent dentition is

$$i \frac{2-3}{2-3}, c \frac{1-1}{1-1}, p \frac{4-4}{4-4}, m \frac{2-3}{2-3} = 44.$$

The form and structure of all the permanent teeth, with the exception of the fourth premolar, are now known.

The deciduous formula is the same as in the genus *Sus*; the permanent one differs by the displacement of the first deciduous molar

by a true premolar. Whilst, however, the *Dichodon* resembles the Hog-tribe in the kind and number of its teeth, it resembles more the Ruminantia in the configuration of the true molars. The now ascertained facts of the deciduous dentition of the *Dichodon* supply an additional test of its affinities, owing to the marked difference in the times and order of succession of the permanent teeth, between the non-ruminant and the ruminant Artiodactyles.

In the Ox and Sheep the last true molar cuts the gum before any of the premolars appear, and the canine teeth are the last to come into place. In the Hog the canines appear before the premolars, and these rise into place before the last molar has attained the level of the other grinders. In the *Dichodon* the second true molar is in place before any of the deciduous teeth have been shed; and it more resembles the Sheep in the order of appearance of the permanent teeth. But there is some difference, for by the time the second true molar is as far advanced in development as in the *Dichodon*, figured in plate 4 of vol. iv. Quart. Journ. of Geol. Soc., the first permanent incisor is in place, and the germs of the premolars in the formative cavities have calcified crowns. The adult *Dichodon* appears to have equalled in size a South Down sheep: the probable age of the immature individual above referred to might be surmised from the analogies presented by the subjoined Table of the times of appearance of the permanent teeth in the—

Symbols.	Ox.				Sheep.				Hog.	
	Early.		Late.		Early.		Late.		Year.	Month.
	Year.	Month.	Year.	Month.	Year.	Month.	Year.	Month.		
i 1	1	9	2	3	1	0	1	4 to 8	1	0
i 2	2	3	2	9	1	6	2	0 to 4	1	6
i 3	2	9	3	3	2	3	2	9 to 12	0	9
c	3	3	3	9	3	0	3	6	0	9
m 1	0	4	0	6	0	3	0	6	0	6
m 2	1	3	1	8	0	9	1	0	0	10
m 3	2	0	2	3	1	6	2	0	1	6
p 2	2	6	2	8	2	0	2	6	1	0
p 3	2	6	2	8	2	0	2	6	1	0
p 4	2	8	3	0	2	3	2	6	1	3

The symbols of the teeth are explained in the author's paper "On the Homologies of the Teeth," in Reports of the British Association, 1848; and in Orr's 'Circle of the Sciences,' 8vo, 1854.

The additional specimens of the *Dichodon* described in this paper are from the Upper Eocene beds; one from the Isle of Wight is preserved in the private collection of Dr. Wright of Cheltenham; the rest, from Hordwell, Hants, form part of the Collection of Fossils in the British Museum.

2. "On a Fossil Ophidian from Karabournou, Salonica Bay." By Professor Owen, F.R.S., F.G.S.

The vertebrae here described, thirteen in number, indicated by their size a serpent of between 10 and 12 feet in length. They were discovered some years since by Capt. Spratt, R.N., in the fresh-

water tertiary beds at the Promontory of Karabournou. Supposing them to have been derived from other parts than the anterior fourth part of the trunk, they resemble in the length of the hypapophysis the vertebræ of *Crotalus*, *Vipera*, and *Natrix*; which they also resemble in the presence of a process developed from both the upper and lower part of the diapophysis. The results of a minute comparison of all the parts of the complex vertebræ of ophidian reptiles were given, which rendered it probable that the Salonica fossil serpent resembled those genera in which the hypapophysis is well developed from all the trunk vertebræ: the breadth of the base of the neural arch indicates that they have been from about the middle of the trunk. They offer so many points of resemblance with those of the Rattlesnake and Viper, that they may have belonged to a venomous species, but they are specifically distinct from those existing serpents: they differ generically and in a very marked degree from the vertebræ of the great constricting serpents (*Python* and *Bou*), as well as from the large fossil serpent (*Palæophis*) of the Eocene Tertiary formations. A summary of the known existing serpents of Southern Europe and Asia Minor was given, showing that none of the living species equal in bulk the fossil serpent. "A classical myth embalmed in the verse of Virgil and embodied in the marble of the Laocoon would indicate a familiarity in the minds of the ancient colonists of Greece with the idea at least of large serpents. But according to actual knowledge, and the positive records of zoology, the serpent between 10 and 12 feet in length from the tertiary strata of Salonica must be deemed an extinct species." For this fossil Professor Owen proposed the name of *Laophis crotaloides*.

3. "On some additional Cambrian Fossils from the Longmynd." By J. W. Salter, Esq., F.G.S.

In March 1856 Mr. Salter communicated the discovery of traces of Annelides and probable fragments of a Trilobite, accompanied by ripple-marks, in the sandstone-beds of the eastern part of the Longmynd. During the last summer he collected many more materials for the elucidation of the palæontology of the Longmynd rocks; and in the present paper described the occurrence of abundant annelide markings, referable to two species (one of them new), throughout a mile of thickness in the lower portion of the nearly vertical shales, sandstones, and flagstones of the Longmynd, from Church Stretton to the Portway.

Wave- or surf-marks, ripples, sun-cracks, and rain-prints were also described as occurring at several localities on the surfaces of these laminated rocks of the Longmynd.

Arenicolites sparsus was proposed as the name for the new species of double worm-hole above alluded to. Mr. Salter also adverted to the discovery of numerous vertical worm-tubes in the quartz rock of the Stiper Stones. These he believes to be the same as the *Scolithus linearis* of Hall, found in the Potsdam sandstone of North America.

He proposes the term *Arenicolites* for all fossil worm-holes with double openings, and *Helminthites* for the superficial trails.

4. "On some Species of *Acidaspis* from the Lower Silurian beds of the South of Scotland." By Professor Wyville Thomson. Communicated by J. W. Salter, Esq., F.G.S.

The author described three new species of the trilobitic genus *Acidaspis*, from the Lower Silurian flagstones with Graptolites and Orthoceratites of Pinwhapple Glen, and one from the overlying sandstone of Mullock Hill, Ayrshire. The names proposed for these species were *Acidaspis Lalage*; *A. hystrix*; *A. unica*; and the fourth, *A. callipareos*.

5. "On two Silurian Species of *Acidaspis* from Shropshire." By J. W. Salter, Esq., F.G.S.

In this communication Mr. Salter gave descriptions and figures of *Acidaspis coronata*, sp. nov., from the Lower Ludlow Rock, and *A. Caractaci*, from the Caradoc or Bala Sandstone of Gretton. The latter species had been previously described, but not figured.

MISCELLANEOUS.

Observations on the Organization and Reproduction of the Volvocinæ. By F. COHN.

THE author states that his observations on *Volvox globator* have convinced him that its proper place is amongst the Algæ. In it, as in the *Eudorinæ*, *Gonia*, *Stephanosphæra*, and other *Volvocinæ*, each spherule is not so much an individual properly so called, as an association or family of individuals,—a sort of vegetable polypary. A globe of *Volvox* is formed at its periphery by an infinity of very small six-sided cells, soldered together like the elements of an epidermic tissue. Each of these cells is furnished with two moveable cilia, and may be compared to a *Chlamydococcus*; its green endochrome is as it were suspended in its cavity, and only touches its walls by means of filiform processes.

Like all Algæ, *Volvox* possesses two modes of reproduction, but hitherto only one of these has been known to naturalists: this consists in a continual division of their cells, and recalls the scissiparity of *Chlamydococcus* or *Gonium*, or that of most of the *Palmellaceæ*. In each sphere of *Volvox* there is never more than a very small number of utricles, which are charged with this part of multiplication. By the continual binary division of their endochrome, these special utricles, which are simple at first, come to contain as many as 12,000 distinct cells, and thus become so many new spheres, which soon free themselves.

The second mode of reproduction of the *Volvox* requires a sexual concurrence, and is not observed indifferently in all individuals. The spherules endowed with sexuality are recognizable by their size and by the greater number of their component utricles; they are generally monocious, that is, they contain both male and female cells; but the greater part of their elements is neutral. The female cells soon exceed their neighbours in size; they acquire a deeper green tint, and become elongated, in the manner of a mattress, towards the

centre of the *Volvox*. The endochrome of these cells undergoes no division. In other utricles, on the contrary, which acquire the volume and form of the female cells, the green plastic matter divides symmetrically into an infinity of very small parts, or linear corpuscles, aggregated into discoid bundles. These are beset with vibratile cilia, and oscillate in their prison, slowly at first, but afterwards more rapidly, and they soon dissolve into their constituent elements. The free corpuscles are very active, and it is impossible not to recognize them as true spermatozoids; they are linear, and thickened at their posterior extremity; two long cilia are situated behind their middle; and their rostrum, which is curved like the neck of a swan, is endowed with sufficient contractility to execute the most varied movements. These spermatozoids, as soon as they can diffuse themselves in the cavity of the *Volvox*, soon collect about the female cells, and succeed in penetrating into their interior; there they fix themselves by their rostrum to the plastic globule in each cell which is to form a spore, and gradually become incorporated with it. Fecundation thus effected, this reproductive globule envelopes itself successively with an integument beset with conical pointed processes, and with an inner smooth membrane; the chlorophyll which it contains then gives place to starch, and a red or orange-coloured oil. This is the mature spore, of which the author has seen forty in one sphere of *Volvox*. The author has not observed the germination of these spores.

He adds, that there is no doubt that the *Sphærosira Volvox* of Ehrenberg is a monœcious *Volvox globator*; that his *V. stellatus* is the same *V. globator* filled with spinose or stellate spores; and that his *V. aureus* only differs from the common *Volvox* by having accidentally smooth spores.—*Comptes Rendus*, 1 Dec. 1856, p. 1054.

List of Phanogamous Plants collected by Dr. E. K. KANE on the Western Coast of Greenland, from 73°–80° North. Extracted from his "Arctic Explorations," ii. 445.

Dr. Kane and his parties having penetrated much further towards the Pole than any of the other Arctic expeditions, and succeeded in arriving at what is perhaps the northern extremity of Greenland, and at an open Polar Sea of unknown extent, the list of the plants brought back by them possesses interest—(1) from its raising the total number of N. Greenland plants from forty-nine to seventy-six; (2) by showing that there is little or no difference in the vegetation throughout the whole extent of the Greenland coast from the 67th to the 81st degree; (3) by proving that two plants, *Hesperis Pallasi* and *Vesicaria arctica*, flourish on the most northern land that has been discovered, although they had previously been noticed only in the milder regions of the Polar zone. Mr. E. Durand, the editor of the botanical appendix to Dr. Kane's book, remarks upon this latter fact, that, although limited to the appearance of two species, it "seems to indicate peculiar isothermal influences, depending either on warm currents, greater depth of water, or actual depression of our globe at its poles."

Mr. Durand also observes, that "another remarkable feature of Dr. Kane's collection is, that, dividing into two equal parts the whole extent of coasts visited by him, and each section presenting about the same number of stations at which herborizations were made, the northern section, from Upernavik to Washington Land, has yielded more dicotyledonous plants than the southern, from Fiske Fiord to 73°; and Smith's Sound alone, only three degrees in length, has proved nearly as rich."

After these few remarks, we subjoin the list of species:—

<i>Ranunculus nivalis</i> , <i>a</i> , Linn.	<i>Saxifraga flagellaris</i> , Willd.
— <i>nivalis</i> , <i>β</i> , Br.	— <i>aizoides</i> , Vahl.
— <i>Sabini</i> affinis.	— <i>tricuspidata</i> , Retz.
<i>Papaver nudicaule</i> , Linn.	— <i>crispitosa</i> , <i>β</i> , Hook.
<i>Heperis Pallasii</i> , T. & Gr.	— <i>aizoon</i> , Jacq.
<i>Vesicaria arctica</i> , <i>a</i> , Hook.	— <i>nivalis</i> , <i>a</i> , Linn.
<i>Draba alpina</i> , <i>β</i> , Br.	— —, <i>β</i> , Linn.
— — <i>corymbosa</i> .	— <i>foliolosa</i> , Br.
— — <i>micropetala</i> .	— <i>cernua</i> , Linn.
— —, var.	<i>Gnaphalium sylvaticum</i> , Linn.
— <i>glacialis</i> , <i>β</i> , Hook.	<i>Hieracium vulgatum</i> , Fries.
— <i>rupestris</i> , <i>a</i> , Br.	<i>Arnica angustifolia</i> , Vahl.
— <i>nivalis</i> , Willd.	<i>Taraxacum palustre</i> , DC.
— <i>hirta</i> , Linn.	<i>Campanula uniflora</i> , Linn.
<i>Cochlearia fenestrata</i> , Br.	<i>Vaccinium uliginosum</i> , Linn.
<i>Arenaria grønlandica</i> , Spr.	<i>Cassiope tetragona</i> , Don.
— <i>arctica</i> , var., Hook.	<i>Pyrola chlorantha</i> , Sw.
<i>Stellaria longipes</i> , <i>δ</i> , T. & G.	<i>Pedicularis arctica</i> , Br.
— —, <i>ε</i> , T. & G.	— Kanei, Durand.
<i>Cerastium alpinum</i> , <i>a</i> , Linn.	— <i>hirsuta</i> , Linn.
— —, var.	<i>Diapensia lapponica</i> , Linn.
<i>Silene acaulis</i> .	<i>Polygonum viviparum</i> , Linn.
<i>Lychnis apetala</i> , <i>a</i> , Linn.	<i>Oxyria digyna</i> , Campd.
— —, <i>β</i> .	<i>Empetrum nigrum</i> , Linn.
<i>Dryas octopetala</i> , Linn.	<i>Salix arctica</i> , Br.
— <i>integrifolia</i> , Vahl.	— <i>herbacea</i> , Linn.
<i>Alchemilla vulgaris</i> , Linn.	<i>Luzula hyperborea</i> , Br.
<i>Potentilla pulchella</i> , Br.	— <i>arcuata</i> , Mey.
— <i>nivea</i> , <i>β</i> , Hook.	<i>Carex rigida</i> , Good.
— —, var., T. & G.	<i>Eriophorum polystachyon</i> , Linn.
— <i>frigida</i> , Vill.	<i>Alopecurus alpinus</i> , Eng. Bot.
— <i>tridentata</i> , Ait.	<i>Agrostis canina</i> , Br.
<i>Epilobium angustifolium</i> , Linn.	<i>Poa arctica</i> .
— <i>latifolium</i> , Linn.	— <i>alpina</i> , Linn.
<i>Sedum Rhodiola</i> , DC.	<i>Festuca ovina</i> , Linn.
<i>Saxifraga oppositifolia</i> , Linn.	<i>Trisetum subspicatum</i> , Linn.

Mr. Durand states, that the additions to the North Greenland column of Dr. Richardson's Statistical Tables (where the generic names only are given) are—

<i>Ranunculus Sabini</i> .	<i>Cerastium</i> , var. (probably a new species).
<i>Heperis Pallasii</i> .	<i>Dryas octopetala</i> .
<i>Vesicaria arctica</i> .	<i>Alchemilla vulgaris</i> .
<i>Draba</i> (3 species).	<i>Potentilla frigida</i> .
<i>Arenaria arctica</i> .	

Sedum Rhodiola.
Saxifraga (2 species).
Gnaphalium sylvaticum.
Hieracium vulgatum.
Vaccinium uliginosum.
Pyrola chlorantha.
Diapensia lapponica.

Pedicularis (2 species).
Empetrum nigrum.
Salix (1 species).
Eriophorum (2 species).
Agrostis canina.
Festuca ovina.

There is only one undoubtedly new species in the collection, viz.—

“*Pedicularis Kanei* (Durand). Caulibus compluribus; foliis linearibus glabris; pinnulis minutis, omnibus remotis, rachi petioloque vix dilatatis; corolla rosea, galea edentata.

“Planta quam præcedens [*P. arctica*] robustior, radice carnosâ palmatim ramosa. Caules complures, vix lanati; folia linearia, glabra, pinnatifida; pinnulæ minutæ, omnes remotæ, margine rursum fere integræ, deorsum acute serratæ; petiolus foliorumque rachis vix dilatati; prior ad basin parce lanatus. Spica densa; bractæe lanuginosæ angustolanceolatæ, fere integræ, ad apicem tantummodo obscure paucidentatæ. Calyx 5-6-fidus, lana alba densissima implexus; corolla rosea, textura tenerrima, calyce duplo longior; labium inferius tripartitum, suberoso-dentatum; lobus medianus subrotundus (in præcedenti emarginatus), galea minus incurva, angustior, edentata. Stamina filamenta pilosa; stigma subrotundum, papillosum, integrum; germen subglobosum.

“*P. Kanei* is easily distinguished from *P. arctica* by the delicacy of its pinnules, which are all remote, on a rachis scarcely dilated; by its bracts, perhaps more lanuginous, but almost entire; by its rose-coloured flowers, its edentate helmet, and the thin texture of its corolla and calyx. The middle lobe of the inferior lip and stigma are not emarginate, as in *P. arctica*, and the germ is of a more globose form. It is, moreover, a larger plant, with many more stems, and a more fleshy root.”—Kane's Arctic Explor. ii. 458.

Gathered on the coast of Smith's Sound.

Only one fern is mentioned as found to the north of 73°, viz. *Cystopteris fragilis*, at Wolstenholm, 76°.

One new moss also is recorded, viz.

“*Bryum lucidum* (James). This species in all its characters resembles *B. crudum*, except the capsule, which is oval, without a collum, and not pyriform, and of a dark brown colour.”—l. c. 465.

We must refer to the Essay itself for many other valuable and interesting remarks.

Remarks on young Bony Pikes (Lepidosteus).

By Professor AGASSIZ.

Mr. J. E. Gavit exhibited to the American Association at Albany a vase containing young Gar-Pikes 4 to 6 inches long, from Lake Ontario, which called forth some remarks from Prof. Agassiz. The point of special interest in these representatives of the ancient Ganoids was the occurrence of an upper lobe to the caudal fin *containing the prolonged vertebral column*. It was placed directly above that fin, was of equal length, and had a lanceolate form; it moreover had a

peculiar rapid vibratile motion. The vertebral column was continued in it quite to its extremity. These young fishes therefore were essentially identical in their tails with the Palaeozoic species, and in one genus of the Old Red Sandstone, named *Glypticus*, as stated by Prof. Agassiz, the tail was similar in the form of the lobes. This supernumerary lobe disappears as the fish grows older. Prof. Agassiz observed, that this was among the many facts which show that the order of succession of animals in past time is exemplified now in the development of individuals. He also remarked on the fact that these Ganoid fishes resemble reptiles in the power of moving the head on the back-bone (owing to the ball-and-socket joint of the vertebrae), and in the quasi tail.—*Silliman's Journal*, Nov. 1856.

METEOROLOGICAL OBSERVATIONS FOR DEC. 1856.

[The insertion of carefully prepared Meteorological Reports in the principal daily Papers has rendered our Table and Observations, which from the nature of our publication cannot appear within less than a month after date, of so little value, that the Editors have determined to discontinue them. In doing so they beg to return their thanks to those gentlemen who for so many years have kindly contributed the information.]

Chiswick.—December 1. Severe frost: fine, but cold. 2. Clear and frosty. 3. Rain. 4. Frosty and foggy: rain. 5. Foggy and drizzly: rain at night. 6. Densely clouded: rain. 7. Boisterous: cloudy: fine. 8. Densely overcast: cloudy: rain. 9. Fine: cloudy: rain at night. 10. Rain: densely clouded. 11. Partially overcast: fine: rain at night. 12. Clear: very fine in forenoon: cloudy at night: heavy rain. 13. Rain: cloudy and fine. 14. Slight rain: cloudy and fine. 15. Clear and fine: frosty at night. 16. Sharp frost: clear: foggy. 17. Frosty and foggy: cloudy at night. 18. Hazy: drizzly: slight rain. 19. Clear and fine throughout: slight frost at night. 20. Frosty: hazy: cloudy. 21. Overcast. 22. Cloudy. 23. Partially overcast: clear: cloudy. 24. Rain: clear and very fine: frosty at night. 25. Foggy: sharp frost. 26. Cloudy: frosty. 27. Clear and frosty: severe frost at night. 28. Frosty: clear: sharp frost. 29. Clear and frosty: overcast. 30. Hazy. 31. Cloudy.

Mean temperature of the month 39°·03

Mean temperature of Dec. 1855 33·99

Mean temperature of Dec. for the last thirty years 39·48

Average amount of rain in Dec. 1·479 inch.

Boston.—Dec. 1. Fine. 2. Fine: snow P.M. 3, 4. Fine. 5. Cloudy: rain A.M. 6. Fine: rain P.M. 7. Cloudy: rain A.M. and P.M. 8, 9. Cloudy. 10. Cloudy: rain A.M. 11. Cloudy: rain P.M. 12, 13. Fine: rain P.M. 14–16. Fine. 17. Cloudy. 18. Cloudy: rain A.M. 19. Fine. 20. Cloudy. 21. Cloudy: rain P.M. 22–26. Fine. 27. Fine: snow P.M. 28. Fine. 29. Fine: rain P.M. 30. Cloudy. 31. Fine.

Sandwich Manse, Orkney.—Dec. 1. Bright A.M.: clear P.M. 2. Snow-showers A.M.: clear P.M. 3. Cloudy A.M.: showers, thaw P.M. 4. Snow-showers A.M.: rain P.M. 5. Drops A.M.: rain P.M. 6. Showers A.M. and P.M. 7. Cloudy A.M.: showers P.M. 8. Cloudy A.M.: clear, fine P.M. 9. Cloudy A.M.: rain P.M. 10. Damp A.M.: showers P.M. 11. Cloudy A.M. and P.M. 12. Cloudy A.M.: fine, showers P.M. 13. Cloudy A.M.: fine, clear P.M. 14. Showers A.M.: cloudy P.M. 15. Cloudy A.M. and P.M. 16. Cloudy A.M.: showers P.M. 17. Cloudy A.M.: damp P.M. 18. Showers A.M.: clear P.M. 19. Drizzle A.M.: cloudy P.M. 20. Drizzle A.M. and P.M. 21. Drizzle A.M.: rain P.M. 22. Hail-showers A.M. and P.M. 23. Snow A.M. and P.M. 24. Thaw A.M.: cloudy, sleet P.M. 25. Frost, bright A.M.: snow-showers P.M. 26. Frost, bright A.M.: snow-showers P.M. 27, 28. Hail-showers A.M. and P.M. 29. Bright A.M.: drops P.M. 30. Showers A.M.: drizzle P.M. 31. Drizzle A.M.: rain P.M.

Mean temperature of Dec. for previous twenty-nine years ... 40°·97

Mean temperature of this month 39·38

Mean temperature of Dec. 1855 39·41

Average quantity of rain in Dec. for sixteen previous years ... 4·23 inches.

**Meteorological Observations made by Mr. Thompson at the Garden of the Horticultural Society at Camwick, near London;
by Mr. Veall, at Boston; and by the Rev. C. Clouston, at Sandwick Mease, Orkney.**

Days of Month.	Barometer.				Thermometer.				Wind.		Rain.	
	Camwick.		Orkney, Sandwick.		Charwick.		Orkney, Sandwick.		(Charwick) p.m.		Orkney, Sandwick.	
	Max.	Min.	5 a.m.	5 p.m.	Max.	Min.	5 a.m.	5 p.m.				
1.	29.936	29.900	29.89	29.95	35	15	21	30	NW.	NW.	.....	.....
2.	29.938	29.907	29.80	29.80	35	19	18	30	NW.	NW.	.....	.....
3.	29.964	29.956	29.70	29.65	37	24	22.5	31	NW.	NW.	.....	.....
4.	30.043	29.920	29.62	29.62	38	30	15	33	NW.	NW.	.....	.....
5.	29.647	29.971	29.47	28.95	55	40	33.5	35	NW.	NW.	.....	.....
6.	29.502	29.971	28.99	28.64	57	51	43.5	45	NW.	NW.	.....	.....
7.	29.564	29.923	28.99	28.84	60	53	60	45	NW.	NW.	.....	.....
8.	29.553	29.942	28.87	28.97	59	51	55	49	NW.	NW.	.....	.....
9.	29.500	29.904	28.91	28.57	59	50	51	48	NW.	NW.	.....	.....
10.	29.419	29.973	28.78	29.13	56	43	51.5	48	NW.	NW.	.....	.....
11.	29.512	29.906	29.31	29.26	52	42	45	41	NW.	NW.	.....	.....
12.	29.318	28.955	29.06	28.96	54	39	43	41	NW.	NW.	.....	.....
13.	29.093	28.834	29.01	29.24	49	39	37	42	NW.	NW.	.....	.....
14.	29.922	29.912	29.65	30.02	47	31	38	40	NW.	NW.	.....	.....
15.	30.465	30.222	30.20	30.22	42	21	34	40	NW.	NW.	.....	.....
16.	30.540	30.335	30.00	29.97	39	20	29	47	NW.	NW.	.....	.....
17.	30.435	30.120	30.08	29.83	44	31	34	41	NW.	NW.	.....	.....
18.	30.098	29.932	29.76	30.02	48	32	41	45	NW.	NW.	.....	.....
19.	30.402	30.150	29.91	29.99	44	32	31.5	49	NW.	NW.	.....	.....
20.	30.426	30.187	29.90	29.91	47	43	43	50	NW.	NW.	.....	.....
21.	30.422	30.120	29.91	29.65	47	42	43	48	NW.	NW.	.....	.....
22.	30.103	29.906	29.73	29.98	47	35	43.5	37	NW.	NW.	.....	.....
23.	30.030	29.964	29.91	29.34	41	29	32	29	NW.	NW.	.....	.....
24.	29.473	29.914	28.94	29.00	46	22	33.5	35	NW.	NW.	.....	.....
25.	28.867	28.862	29.18	29.27	34	18	27.5	32	NW.	NW.	.....	.....
26.	29.041	28.937	29.27	29.26	35	24	32	30	NW.	NW.	.....	.....
27.	29.380	28.911	29.15	29.11	32	11	28	32	NW.	NW.	.....	.....
28.	29.770	29.910	29.16	29.49	30	21	16	36	NW.	NW.	.....	.....
29.	30.122	30.055	29.71	29.68	42	33	27	34	NW.	NW.	.....	.....
30.	30.232	30.136	29.68	29.47	47	40	40	40	NW.	NW.	.....	.....
31.	30.207	30.129	29.65	29.52	50	45	44	44	NW.	NW.	.....	.....
Mean.	29.835	29.663	29.463	29.475	45.09	32.97	35.9	39.58			1.88	1.27
								39.18				5.17

THE ANNALS
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[SECOND SERIES.]

No. 111. MARCH 1857.

XV.—*On the Mechanism of Aquatic Respiration, and on the Structure of the Organs of Breathing in Invertebrated Animals.*
By THOMAS WILLIAMS, M.D., F.L.S., Physician to the Swansea Infirmary.

[Concluded from vol. xvii. p. 258.]

[With a Plate.]

Cephalopoda.*

THE Cephalopod Mollusks stand at the head of the Invertebrated series, not only in virtue of a superiority of bodily form, but also of the higher type of structure which pervades their entire organization. They depart from the Gasteropods in the position and shape of their principal prehensile and locomotive organs, and in the significant fact that in them the 'general cavity' of the body is almost obliterated. They approach the Vertebrated animal in the following respects:—They possess a rudimentary endoskeleton, greatly developed cephalic ganglions, large and active organs of sense, a vigorous and well-formed muscular system, a blood-vascular apparatus more perfect than that of any other class of Invertebrata, a nutritive fluid thickly fibrinized and of high specific gravity, and blood-corpuscles which in figure and structure more nearly resemble those of the Mammal than do those of any other Invertebrated animal. The circulatory apparatus of the Cephalopoda does not, however, constitute a perfectly closed system. This point was established by the early classic researches of Professor Owen. The cephalic venous sinus, and

* The author regrets that, in consequence of various engagements, he has been obliged to postpone so long the publication of this last paper, which completes the series published in the 'Annals' under the above title from time to time during the years 1854-1856.

its continuation, the great anterior vena cava, appear to form closed-off portions merely of the peritoneal cavity. The vena cava in *Nautilus* is a flattened spacious channel, the parietes of which are perforated by numerous orifices which communicate directly with the peritoneal cavity. This remarkable peculiarity is thus described by Professor Owen: "There are several small intervals left between the muscular fibres and the corresponding round apertures in the membrane of the vein (vena cava) and contiguous peritoneum, by which the latter membrane becomes continuous with the lining membrane of the vein; from this structure it would seem that the *blood might flow into the peritoneal cavity*, or the fluid contents of that cavity be absorbed into the vein*."

Though, from the small size of the specimens upon which the author's observations have been conducted, he has not been successful in his attempts to verify the statements of Prof. Owen, he thinks it very probable, on the ground of analogy, that they are true. In the Echinoderms and Annelids the vascular system undoubtedly communicates with the peritoneal cavity. Of the Gasteropod Mollusks Milne-Edwards observes, "L'artère aorte, parvenue au point où le canal digestif se recourbe pour descendre de la face supérieure du bulbe pharyngien dans la cavité abdominale, débouche directement dans une vaste lacune, dont les parois sont formées en partie par les téguments communs de la tête et en partie par les muscles et les tuniques du pharynx jointes à les lames de tissu connectif étendues transversalement au devant de la cavité abdominale†." The cephalic sinus in the Gasteropods forms a part of the arterial system; in the Cephalopods it is a segment of the venous system. That portion of the circulatory system of the Cephalopod which is intermediate, *in the solids of the body*, between the arteries and veins, partakes much more strikingly of the capillary character, or less of the lacunose, than it does in any other Mollusk. It seems, from the researches of Prof. Owen, that in *Nautilus* and *Octopus*, and other genera, the pericardium (or that membrane which embraces the large central vessels) opens immediately into the branchial chamber. Dr. Lacaze Duthiers‡ has lately shown that the pericardial chamber in the Lamellibranchiata also opens externally. From these analogies the writer of this paper believes that the lung-sac of the pulmonary Gasteropods should be looked upon as the pericardial bag slightly diverted from the character which is normal to it in other Mollusks.

Considered from this homological point of view, the lung of

* Cyclop. Anat. and Phys., Art. Cephalopoda.

† Ann. d. Sc. Nat. 3 sér. 1847.

‡ Ann. d. Sc. Nat. No. 5, 1855.

the Pulmonata should be described as the pericardium, receiving air instead of water into its interior. The vascular system of Insecta is filled with air, that of the Annelids with fluid. Insects differ from the Annelids, therefore, precisely in the same manner as the Pulmonata differ from other Mollusks. But, notwithstanding the express provisions which are thus made to introduce the external element into the recesses of the body of Cephalopods, these Mollusks are furnished with branchial organs more beautifully and elaborately constructed than those of any other Invertebrated animal.

The general anatomy of this class is well known. The author therefore will at once proceed to state the results of his special researches on the minute structure of the respiratory organs.

Mechanism of the Branchial Chambers.

The branchial chamber of the Cephalopod is a perfect hydraulic mechanism. It is placed in advance of the viscera. It is enclosed laterally by the mantle, the muscles of which have received an express disposition with reference to the rhythmic respiratory movements which it is designed to perform. Anteriorly the chamber is provided with two valvular openings, the valves being so arranged as to afford a ready entrance to the inspiratory water-current, and to prevent its reflux. The water thus drawn or sucked into the breathing-chamber is drawn or sucked also into the hollow axes of the gills (especially in *Octopus*) by a diastolic movement of these organs which seems to be synchronous with that of the mantle. Having freely permeated the branchiæ, the water is expelled through the funnel by an expiratory act in which the gills and the mantle contract simultaneously. The rectum and the ducts of the generative system terminate in this chamber at the base of the funnel. The expiratory current thus conveys externally the excreta. In this character, as is well known, the Cephalopods coincide with the Gasteropods.

The *precise mode* in which the water, during the respiratory movements, traverses the branchiæ, has only recently become known to the author*. It does not enter, as he formerly supposed,

* In a former paper (see *Annals*, ser. 2. vol. xvi. pl. 9) I introduced a figure (fig. 7) illustrative of the manner in which I then believed the water to pass through the branchiæ in the act of respiration. Although it was intended only to convey a *general* idea of the mechanism of the chamber and its currents, yet as that figure stands, it may lead to error. The hollow axes of the gills are not *open*, as there represented, at their posterior or attached extremity, but *conically closed*, as they are at the anterior extremity. It will be evident, in the text, that the water cannot therefore enter the interior of the organ in *one* large stream, as there shown.

as one current at the posterior extremity, but from above downwards, from the dorsal to the ventral side, in as many streams as there are spaces (Pl. XV. fig. 1 *e*) between the secondary lobuli of the organs. By this arrangement the inspiratory pure current is first and at once brought into contact with that half of the gill on which the vascular laminae are suspended. It effects its escape, during the systole of the organ, at the ventral side, through the fissures between the non-vascular supports of the lobuli (*d, d*). Although in the genus *Loligo* the gill (fig. 3, 3^a) does not fold so much upon itself as to enclose a cylindrical axis, as in *Octopus* (fig. 1), the water-currents observe precisely the same direction in both. The admission of the aerating element apparently into the interior of the gill in the Cephalopods may be said, on the one hand, to be parallel to what occurs in the Lamellibranchiata, or, on the other, may be likened to the entrance of the air, in the Mammal, into the lungs. As a respiratory mechanism, it resembles the latter more than the former. The lungs possess the property of dilating and contracting, in order to inhale and exhale the gases concerned in respiration. The branchiae of the Cephalopod are endowed with the same property. They bear a nearer similarity to the gills of the Pectinibranchiata than to those of any other Mollusks. They are highly muscular and irritable: the disposition of the muscles will be afterwards described. On the floor of the branchial chamber, situated immediately underneath each gill, and running parallel with these organs, may be observed a dense prominent ridge (Pl. XV. fig. 1 *h, h*), to which the branchiae are attached, and upon which they rest. This ridge consists of a dense bundle of muscles, which during contraction are capable of approximating closely together the two extremities of the branchiae—in other words, of shortening these organs in length. These muscles are richly supplied with nerves from the neighbouring pallial ganglion. They aid in a very material manner the branchial movements of dilatation and contraction. They not only afford a fixed point of attachment to the gills, but they are accessory to the mantle in the respiratory movements.

Structure of the Branchiae.

The Tetrabranchiate and Dibranchiate orders are founded simply upon the number of the gills*. No classification has been attempted on the basis of the remarkable varieties which occur in the anatomical structure of the gills. As far as the

* The second pair of branchiae in the Tetrabranchiate Cephalopods are most probably parallel to, and representative of, the supplementary gills of the Lamellibranchiata described in a former paper.

author's examinations have extended, he has succeeded in establishing only two main varieties,—that of *Octopus* and *Sepia* (Pl. XV. fig. 1), in which the secondary lobuli circumscribe a hollow axis, by curving from the dorsal to the ventral aspect; and that, 2ndly, of *Loligo* and *Loligopsis* (Pl. XV. fig. 3, 3^a), in which the secondary parts of the organ pass only half-way round, and float freely in the branchial chamber, instead of being, as in *Octopus*, tied down to the longitudinal pallial muscle upon which the gills rest. He has no doubt, however, that other modifications of structure in the branchial organs of this class exist; but, in consequence of the want of specimens, he is not at present in a position to speak of them. The Dibranchiate order is thus obviously resolvable into two well-marked suborders,—the one in which the gill forms a *cylinder*; the second, in which it forms a *hemicylinder*. This distinction has never before been noticed.

No example of the Tetrabranchiata has ever fallen under my notice. Prof. Owen states that they stand in closer connexion with the Gasteropod Mollusks than the Dibranchiata. In *Nautilus Pompilius* this distinguished observer figures the branchiæ as having a completely formed cylindrical arrangement.

It must therefore be concluded that the Tetrabranchiata are lower than the Dibranchiata in the Molluscan scale, and that *Octopus* should stand beneath the *Calamary* in zoological rank. This interesting fact, as the ground of classification, is commended to the attention of those who may enjoy opportunities of studying the organization of this most interesting class of animals. In accordance with this view, which regards the gill of *Octopus* as ranking below that of *Loligo*, let us proceed first to the detailed description of the lower variety.

The gills in the genus *Octopus* are strikingly distinguished in apparent structure from those of the other families of the Dibranchiate tribe. Although only two in number, in all the species of this order they exhibit, as stated before, very extraordinary diversities of shape. In the size and disposition of the branchial chamber there is no corresponding variation: it is nearly the same in all species. In *Octopus* the branchia on either side is attached in a peculiar manner to the ventral wall of the breathing-chamber. The dorsal surface is free and unattached: it is so situated as to float on a thin supporting ridge. The water thus rushes into and out of its interior with equal facility. The branchial artery, or afferent venous trunk (fig. 1 b), lies on and courses up along the ventral side of the organ: it emanates from the branchial hearts*. The branchial

* It will afterwards be shown that these cordiform dilatations of the blood-channels in the vicinity of the branchiæ may be viewed as mere safety

vein or efferent trunk (fig. 1 *a*) runs along the dorsal border of the gill, and terminates in the aorta (these two trunks are seen in section, fig. 2 *a, b*). These two longitudinal trunks constitute the framework by which the entire apparatus of the gill is supported. To them are attached respectively the two ends of the secondary lobuli in *Octopus*: in *Loligo*, as will be again explained, a slight variation from this type occurs. The plan of this structure is readily understood on a transverse section of the gill (fig. 2). In the gill of *Octopus vulgaris* there are twelve pinnæ or secondary lobuli on either side (fig. 1 *d, d*). Along the external and internal margins respectively (fig. 2 *i, i*, & *e, e*), efferent and afferent vessels are observed to travel. These secondary branches, like the primary trunks from which they proceed, serve to support, in their turn, the tripinnæ (*g*), or the ultimate leaflets in which are distributed the final capillaries of the branchiæ. As observed by Professor Owen, the gills of this Cephalopod are tripinnate. This general term, however, serves but very rudely to express the extreme refinement of structure and arrangement which these organs exhibit. The secondary and tertiary divisions are so much longer than the straight space between the points to which they are fixed, that in the ordinary state of the animal, after death, they present remarkably complex foldings and convolutions; but when the organ is in the condition of full and complete distension (with blood in the vessels and water in the hollow axis), the secondary lobuli and their appended system of leaflets are straight or smooth laminæ of exquisite slenderness, delicacy, and translucency. Although the secondary divisions (fig. 1 *d, d*) amount to no more than twelve in number on either side, the tertiary laminæ (*c, c*) which each of them supports are as many as from twenty-five to thirty on either side. The multiplication thus insured is extraordinary. The secondary lobuli are separated from each other by free, open water-passages (fig. 2 *h*). It is through these spaces that the fresh inspiratory streams enter the axial interior of the gill (fig. 2). No exact parallel to these spaces is found in any other Mollusk. The water, indeed, rushes between the secondary divisions of the gills in all the Pectinibranchiata. In these latter, however, the organ does not circumscribe a hollow interior. The tertiary branchial foliage is disposed at right angles on the secondary, just as the latter rest at right angles on the main primary trunks. According to this arrangement, no obstacle is offered to the rapid and free passage

receptacles for the retrogressing column of blood (which is either stopped or thrown back in its course during the extreme changes of size which the gills are constantly undergoing), with quite as much propriety as they are now considered to be propulsive hearts.

of the water-current through the gill, above from the outside to the inside, below from the inside to the outside. In a mechanical point of view, there is much to admire in this contrivance. The more forcibly the water is caused to pass through the branchia, the more completely its delicate leaflets are straightened and rendered smooth. All danger from mechanical injury is thus obviated.

The water is drawn into the hollow interior of the gill much more slowly than it is driven out. No violence to the slender structures of the organ can accrue from its forcible ejection, since the spaces through which the water effects its exit are bounded only by tendon and fibrous tissue. Now, it may be asked with great reason, how is it that during the expiratory shortening of the gill, the water does not again escape through the passages by which it entered? It is not difficult to answer this question. When the large longitudinal muscle (fig. 1 *h*, *h*; fig. 2 *c*) which is situated underneath the gill contracts, and thus approximates the two ends of the gill, it brings the dorsal half of the organ closer together, forming the concavity of a curve, while it separates the ventral half, which for the instant forms the convexity of the curve. At this instant the expiratory current escapes. Reversing this movement, it is not difficult to perceive how the act of inspiration occurs.

The gills of all Cephalopods are remarkably elastic; at one moment exhibiting an extraordinary capability of dilatation, at another of extreme contraction. This property is due to the presence of muscular fibres. They are distributed throughout the entire structure of the gill; they embrace the vessels; they course along the edges of the laminae; they are internally intermingled with elastic tissue, whose normal mode of action is rhythmic; they contribute in a most important manner to the mechanism of breathing.

The branchial system of the Cephalopods is distinguished by one further peculiarity:—in no instance yet examined has the presence of vibratile cilia been proved. In this particular they are allied to the gills of the Crustacea and the Fish*. In the Cephalopod, no part whatever of the gill is furnished with cilia. At first it might be thought that its extreme flexibility superseded the necessity for such organules. The instance of the Crustacean gill, however, which is perfectly passive, disproves this imagination. *Why* cilia are denied to the branchiae of the Cephalopod, cannot at present be explained. The fact is attested by all observers.

* I am sorry that, in consequence of the want of specimens, I cannot, from personal knowledge, state at this moment whether the gills of the Pectinibranchiata are ciliated or not.

The *ultimate laminae* (fig. 4 *g, g*) are arranged in a dense parallel series on either side of the secondary processes. They present the same disposition as those of the gill of the Crab. Those of the latter, however, are comparatively stiff leaves; those of the former are contractile and flexible in the highest degree. The tissue of the Cephalopod gill is extremely extensible, that of the Crab is fixed and passive.

It is very difficult to obtain a satisfactory view of the fully-unfolded flat surface of one of these ultimate laminae; but with care, it may be obtained. Each lamina is constructed very much on the plan of that of a Pectinibranchiate gill. It is a leaflike structure, bearing two strata of vessels (fig. 6 *a, b*), an afferent and an efferent, which double the one into the other at the free margin (*c, c*). The aerating current laves thus the advancing and the returning capillary streams of blood. The ultimate blood-channels (figs. 5, 6) bear an exact resemblance to those already described in the gills of the Pectinibranchiata. They are parallel, non-dividing channels, of *unvarying diameter*. At the point of curving (*c, c*), or the free margin, they do not dilate, as in the case of the Lamellibranchiata. From all others they are distinguished by the circumstance of their extreme distensile and contractile capabilities. If these ultimate vessels united and divided in a retiform manner, they would approach to the plan observed in the branchiae of the Fish. They form, however, a straight parallel series, laminarily blended together by delicate cellular tissue (fig. 6). In this character they conform to the Molluscan distinctive type of structure. No instance of departure from this type is known, from the Tunicate to the Cephalopod. From the Pectinibranchiate standard they differ in the absence of cilia. The absence of cilia is compensated in the Cephalopod by the extreme muscularity of the organ.

It is *scarcely possible* in the branchial organs of this class to arrive at a certain knowledge as to the point whether the ultimate laminae are covered or not by an epithelium. The parts are so irritable and transparent, that the question cannot with confidence be determined. That they are not lined by a *ciliated* epithelium is quite certain; that they are not invested by any epithelium at all, is improbable; but the existence of this covering cannot be demonstrated convincingly. The conclusion must therefore rest on general analogy: all analogy is unquestionably in favour of its presence.

The branchiae of *Loligo* (fig. 3, 3^a) differ from those of *Octopus* (fig. 1) in a remarkable manner. In the latter genus the secondary divisions (*c, c*) are attached to the ventral aspect of the organ (fig. 2 *i, i*). In the former they are loose, and float freely in the branchial cavity (fig. 3 *b, b*, & 3^a *c, c*). They thus form

a curved figure, or half-cylinder. The mode of action of the gill during the respiratory act is precisely the same as in the case of the *Octopus*. The water enters and penetrates in the same direction; it escapes expiratorily in the same manner. In all other respects the branchiæ in these two examples are constructed in precise accordance with the same principle. There is no deviation; in minute structure they are the same.

EXPLANATION OF PLATE XV.

- Fig. 1.** The left gill of *Octopus vulgaris*, in situ: *a*, efferent vessel or branchial vein; *b*, afferent vessel or branchial artery; *c*, branchial heart; *d, d*, secondary lobuli of the branchia; *e, e*, tertiary leaflets; *f*, the hindmost lobule, showing that the axis of the gill is closed both behind and anteriorly at *g*; *h, h*, the sub-branchial longitudinal muscle.
- Fig. 2.** Transverse section of the gill (effected through the interlobular space): *a*, branchial vein (in section); *b*, branchial artery; *c*, longitudinal sub-branchial muscle (in section); *d*, attachment to mantle; *e, e, g, g*, secondary lobular artery (or afferent vessel); *f*, the frænum or membrane which forms a framework and supports the branchial foliage, *i, i, i, i*; *h*, represents the water-spaces between the lobuli.
- Fig. 3-3^d.** Gill of the common *Calamary*, viewed from the dorsal side; 3^d, the same, viewed from the ventral side: *a, a*, secondary lobuli; *b, b*, afferent primary and secondary vessels; *c*, the tertiary lobuli.
- Fig. 4.** Transverse section of the gill of the *Calamary*: *a*, efferent vessel, in section; *b*, afferent ditto; *c, c*, secondary efferent trunks; *d, d*, secondary afferent ditto; *e, e, e*, tertiary foliage; *f, f*, water-spaces; *g, g*, vessel; *h*, frænum by which the gill is attached to the mantle.
- Fig. 5.** Plan of ultimate vessels.
- Fig. 6.** Plan of the same at free border.

XVI.—*Characters of Streptaulus, a new genus, and of several species of the Cyclostomacea from Sikkim, the Khasia Hills, Ava, and Pegu.* By W. H. BENSON, Esq.

STREPTAULUS, Bens. Genus novum.

Testa umbilicata, pupiniformis, nitens; peristoma circulare, non continuum, superne tubulo suturali interno et externo, continuo, ad extremitates ambas aperto, siphonem mentiente, perforatum.
Opere. — ?

Streptaulus Blanfordi, Bens., n. s.

Testa umbilicata, oblonga, polita, regulariter oblique striata, striis prope suturam submarginatam fortioribus, lineis nonnullis spirali-bus decussatis, fusco-cornea, translucente; apice obtusiusculo;

anfractibus 5 convexiusculis, penultimo ventricosiori; apertura magna, subcirculari; peristomate simplici, reflexo, subrevoluto, marginibus callo parietali tenui junctis; tubuli suturalis parte externa longa, pone junctionem labri breviter arcuatim elevata, suturam subtus exhibente; umbilico impervio.

Long. $7\frac{1}{2}$, diam. 5 mill. Long. apert. (peristomate incluso) 4 mill.
Hab. prope Darjiling, in montibus Himalayanis Sikkimensibus.
Teste H. Blanford.

A most interesting new form, intermediate between Dr. Pfeiffer's genus *Rhaphaulus* and the Sikkim and Burmese forms of *Alycaeus* exhibited in *A. constrictus*, *Urnulla*, and *Amphora*, B. In the last-named shell the sutural tube commences at a very short distance behind the mouth. In *Streptaulus* the tube is first internal, and on arriving at the aperture is suddenly reflected, and instead of forming an opening in the lip above the aperture as in *R. bombycinus*, or ending in a short upright tube as in *R. Lorraini* or *Chrysalis*, Pfr., it describes a short arch behind the lip, and then runs to some distance along the external suture, as in *Alycaeus*. In texture and colouring *Streptaulus* agrees with *Rhaphaulus*, not with *Alycaeus*, and it is entirely deficient in the strangulation and swelling which characterize the anterior portion of the last whorl in all the species of the latter genus. It inhabits the same tract with *Megalomastoma funiculatum*. None of the larger Pupiform Cyclostomacea are known to travel farther towards the north-west.

Diplommatina diplocheilus, Bens., n. s.

Testa dextrorsa, vix rimata, ovato-conica, subfusiformi, medio ventricosiori, solidiuscula, carneo-albida, vix translucente, leviter nitente; spira conica, apice acuto, sutura profunda; anfractibus $6\frac{1}{2}$ -7 convexis, primis costatis, 3 postremis laevioribus, antepenultimo majori tumido; apertura verticali subauriculari, pallide carnea, nitente, plica columellari valida nutante munita; peristomate duplici, interno continuo expanso, exteriori planato-expanso, infra sinistre angulo saliente desinente, margine sinistro sinuato, callo parietali magno, expanso, superne suturam fere attingente, subtus soluto marginem elevatum efformante. Operculo retractili.

Long. 3, diam. 2 mill.

Hab. ad Teria Ghât, Montium Khasia dictorum portam, satis frequens. *Teste* W. Theobald.

This shell, which, although abundant, was local on limestone rocks, belongs to the division of *Diplommatina* with a conspicuous plait at the edge of the aperture, described by the Messrs. Adams as *Paxillus*, from the Bornean type "*adversa*," which Mr. H. Adams now regards as a *Diplommatina*. The operculum was remarked by Mr. Theobald when the species was freshly taken. *Diplommatina Huttoni*, Pfr., and the two following

species belong to the same type. There is a strong line of separation between the inner and outer peristome in *D. diplocheilus*, and the relief of the parietal callus above the columella is a marked feature.

Diplommatina pachycheilus, Bens., n. s.

Testa dextrorsa, non rimata, ovato-acuminata, lævi, obsolete costulato-striata, pallide cornea, translucente, nitente; spira attenuato-conica, apice obtusiusculo, sutura impressa; anfractibus 7 convexiusculis, antepenultimo majori tumido; apertura verticali, late auriculari, plica columellari valida, transversa, munita; peristomate subduplici, sinuato, incrassato, infra sinistre angulato, callo parietali expanso, appresso, margine columellari sinuato. Operc. —?

Long. 4, diam. $2\frac{1}{2}$ mill.

Hab. ad Darjiling. Teste H. Blandford.

This is the largest of the known Himalayan species, and, judging from the single specimen received, the most modest in sculpture.

Diplommatina polypleuris, Bens., n. s.

Testa dextrorsa, non rimata, oblongo-ovata, confertim oblique chordato-costulata, pallide carnea, apice obtusiusculo, hyalino, sutura profunda; anfractibus 6 convexis, antepenultimo tumidiusculo; apertura verticali, subcirculari, dente columellari munita; peristomate duplici, interiori expansiusculo, externo expanso, ad basin sinistram angulato-rotundato, callo parietali mediocri, appresso. Operc. —?

Long. vix 2, diam. 1 mill.

Hab. ad Nancloi, non raro.

This little species was found by Mr. Theobald at Nancloi Ponji, forty-five miles from Cherra, in $92^{\circ} 30' E.$ and $25^{\circ} 15' N.$ A minute *Diplommatina* was also met with at Cherra, but the specimen sent is in such a state of decay as not to be susceptible of identification and description.

Alycaeus prosectus, Bens., n. s.

Testa mediocriter umbilicata, subcampanulato-depressa, subremote striatula, atriis elevatis spiralibus remotiusculis cincta, ad spatium inflatum anfractibus ultimi confertissime et acutissime costulata, albida, versus apicem mucronatum rubella; spira brevi, sutura profunda; anfractibus 4 convexis, subapicali exserto, ultimo ad latus pone stricturam valde gibboso, tubulum suturalem medio-crem gerente, antice læviori; apertura valde obliqua, circulari; peristomate simplici vel duplici, interiori duplici expansiusculo, exteriori dilatato, superne ad angulum et ad basin alato-producto,

margine columellari angusto. Operculo concavo, laevi, multi-spirato.

Diam. major 7, minor 6, axis 5 mill.

Hab. ad Teria Ghát.

Found abundantly on rocks by Mr. Theobald. It is related to the Burmese *A. umbonalis* (Annals, vol. xvii. p. 225) and to *A. strangulatus*, Hutton. Inferior in size to the former, it is easily distinguished by its sculpture and by the peculiar development of the outer lip at its insertion and base, while the narrow columellar lip gives an appearance of artificial truncation to the peristome at that part. In the variety the internal lip is not developed. The margins of the whorls in the operculum are not conspicuously raised as in *A. umbonalis*.

Alycaeus stylifer, Bens., n. s.

Testa umbilicata, depressa, confertim striatula, ad spatium inflatum confertissime acute costulata, nitente, albida; spira brevi, mucronata, apice obtusulo, sutura profunda; anfractibus 4 convexis, ultimo pone stricturam gibbo, tubulum mediocrem gerente, medio stricturae costam prominentem (intus concavam) exhibente; apertura obliqua, subcirculari, irregulari, sinuata; peristomate simplici, incrassato-reflexo. Operc. —?

Diam. major $5\frac{1}{2}$, minor $4\frac{1}{2}$, axis $3\frac{1}{2}$ mill.

Hab. ad Darjiling. Teste H. Blanford.

The rib behind the outer lip corresponds with a deep sulcus within the aperture. A similar feature is observable in the little Bornean *Alycaeus spiracellum*, A. & R., and in the following species. The single specimen from which the description above given was made is a dead and discoloured shell. The two *Alycae* previously known to inhabit Darjiling are of the pupiform type.

Alycaeus hebes, Bens., n. s.

Testa umbilicata, solidiuscula, depressa, vix striatula, ad spatium inflatum et circa umbilicum confertissime striata, carneo-albida, apicem versus rubella; spira conoidea, apice obtusiusculo, sutura impressa; anfractibus 4 convexiusculis, ultimo ad latus gibboso, tubulum mediocrem suturalem gerente, spatio constricto costa valida retro recumbente munito; apertura obliqua, circulari; peristomate continuo, duplici, interiori porrecto, exteriori expanso, incrassato.

Diam. major 4, minor 3, axis 3 mill.

Hab. ad Teria Ghát. Teste W. Theobald.

This species occurs on rocks, and is distinguished by the structure of the aperture from the small Bornean *A. spiracellum*, A. & R. In the latter species, moreover, the rib behind and

above the aperture is nearly parallel with the peristome, whereas in *A. hebes* it looks like a hoop which had fallen backwards on the whorl. In both species it takes its rise at the right side of the peristome, and ends at the suture, corresponding with an internal sulcus.

Leptopoma Cybeus, Bens., n. s.

Testa anguste umbilicata, tenui, turbinato-conica, striatula, lineis elevatis remotis spiralibus cincta, albida, strigis castaneis undulatis picta; spira conica, apice obtusiusculo, sutura impressa; anfractibus 5 convexusculis, ultimo acute carinato; apertura magna vix obliqua, subcirculari, superne angulata; peristomate expanso-reflexo, margine columellari sinuato. Operculo corneo, 8-spirato.

Diam. major 20, minor 16, axis 14 mill.

Hab. ad Nanclai, raro. Teste W. Theobald.

The narrow umbilicus is nearly hidden by the reflected peristome. A single specimen, in an injured state, has been received. Nanclai is the farthest point to which *Leptopoma* has been traced to the north-west from its eastern focus; and this species vies in size with its Philippine brethren. It leads to *Cyclophorus* through *Lept. Burmanum* and *Cyclophorus expansus*, Pfr. A thin, dead, carinate shell, from Phie Than, on the Tenasserim River, may, in its present condition, be referred either to *Leptopoma*, or, as a variety, to the species of *Cyclophorus* last named, which occurs at the same locality in various states of development, solid and angulate at the periphery, or thinner with an acute carination.

Cyclophorus pinnulifer, Bens., n. s.

Testa late umbilicata, orbiculato-depressa, radiato-striata, striis minutissimis spiralibus decussata, sub epidermide scabra, fusca, albida, superne strigis remotis castaneis radiata; spira planata, apice vix prominulo, sutura profunda; anfractibus 4 convexis, subtus rotundatis, ultimo antice latiori; apertura obliqua, circulari; peristomate leviter expanso, subduplicato, interiori continuo, superne ad angulum vix sinuato, exteriori superne alam verticalem subfornicatam efformante. Operc. —?

Diam. major 13, minor 10, axis 3½ mill.

Hab. ad Teria Ghât, non raro occurrens. Teste W. Theobald.

Related to the Sikkim *C. Phanotopicus* and to *C. Calyx* of Burmah, but more nearly to the latter, from which it is distinguished by its wider last whorl, the absence of any angulation below, and by its more developed peristome. It exhibits a nearer approach to *Pterocyclos*, through *Pterocyclos?* or rather *Cyclophorus brevis*, Martyn, and *Pt. tenuilabiat*us, Metc., than either of those species. Unfortunately the operculum is wanting in

the only specimen forwarded. I conclude, however, that it is flat and horny, as in *Cyclophorus*.

The operculum of *Pt. tenuilabatus*, Metcalfe, has been regarded as Choanopomatous, but I consider it to be merely a modified flatter form of the Pterocycloid operculum, nearly agreeing with that of its ally *Pt. hispidus*, Pearson, possessing a shelly skeleton, concave on the inner side, and with the spiral edges of the volutions on the outer side raised and free.

Cyclophorus? tomotrema, Bens., n. s.

Testa anguste umbilicata, turbinato-pyramidalis, radiato-striatula, liris elevatis spiralibus plurimis, nonnullis majoribus, munita, fusco-cornea; spira conica, apice obtusiusculo albido, sutura bene impressa; anfractibus 5 convexis, ultimo subcarinato; apertura obliqua, subcirculari, livida, supra angulata; peristomate duplici, interiori continuo, expansiusculo, superne ad angulum inciso, exteriori expanso, dilatato. Operc. —?

Diam. $5\frac{1}{2}$, axis 5 mill.

Hab. ad Teria Ghât, raro. Teste W. Theobald.

C.? *scissimargo*, B., of Tenasserim belongs to the same group as this shell. The incision is at the upper end of the parietal margin.

Cyclophorus cryptomphalus, Bens., n. s.

Testa umbilicata, globoso-depressa, solida, oblique striatula, striis obsoletis confertis decussata, albida, superne rufo-castanea albido-fulgurata, fascia lata mediana albida et infra altera lata castanea cincta; spira turbinata, apice acutiusculo, sutura submarginata, anfractibus 5 convexis, ultimo rotundato, subtus valde convexo; apertura subobliqua circulari, albida; peristomate duplici breviter adnato, interno vix porrecto, expansiusculo, externo incrassato, reflexo, supra umbilicum angustiusculum subobtectum late auriculato-expanso. Operc. —?

Diam. major 40, minor 32, axis 25 mill.

Hab. in regione Ava regni Burmanorum.

Collected by Mr. Oldham, Chief of the Geological Survey of India. The only specimen received is in very bad condition in respect to surface. It is allied to *Cycl. volvulus*, Müll., but is distinguished by its more depressed form, and by the auriculate process covering the umbilicus, as in some of the Philippine *Cyclophori*.

Cyclophorus Theobaldianus, Bens., n. s.

Testa mediocriter umbilicata, turbinato-depressa, solidiuscula, lineis filiformibus elevatis flexuosis spiralibus, striisque obliquis clathratodecussata, subtus leviori, castaneo-fusca, superne strigis albidis interruptis picta, subtus area lata pallida, fascia angusta albida

mediana, et infra eam altera lata castanea cincta; spira mediocri, turbinata, apice acutiusculo, sutura distincta; anfractibus 5 convexis, celeriter accrescentibus, ultimo subcarinato, basi convexa; apertura obliqua, subcirculari, ampla, latiuscula, intus albida; peristomate fornicato-reflexo, interdum incrassato, lutescente, breviter adnato, callo parietali superne expansiusculo, angulato-callosa, margine columellari leviter sinuato. Operculo paleaceo, crassiusculo, marginibus anfractuum centralium vix conspicuis, intus umbone minuto munito.

Diam. major 50, minor 39, axis 28 mill.; aperturæ alt. et lat. (perist. incl.) 29 mill.

Hab. ad Thyet Myo, raro occurrens.

Found by Mr. Theobald at the rich locality near the right bank of the Irawadi River, where *Hypselostoma tubiferum*, a small variety of *Cycl. fulguratus*, and other shells were procured.

The thick opaque operculum forms a contrast with the thin horny translucent one of *C. fulguratus*, Pfr.; both species exhibit the central boss which is found in so many of the trans-Gangetic *Cyclophori*. The operculum of *C. Siamensis*, Sow., is thin and translucent, the whorls neatly margined, the inner side highly polished, with a minute central umbo. It is transparent and tinged with orange in the centre, and dark chestnut towards the periphery.

Cyclophorus balteatus, Bens., n. s.

Testa mediocriter umbilicata, solidiuscula, depresso-turbinata, striata, rugis confertissimis vix undulatis spiralibus superne decussata, basi glabra, saturate castanea, baltea angusta mediana, superne laciniata, et periomphalo lato lacteis; spira breviter turbinata, apice acutiusculo; anfractibus 5 convexis, celeriter accrescentibus, penultimo compressiusculo, ultimo rotundato, subtus convexo, ad suturam planulato, antice sensim descendente; apertura obliqua, ovato-circulari, intus lactea; peristomate expanso, inæqualiter incrassato-reflexo, albedo, superne undato, marginibus callo brevi, superne angulato, junctis; umbilico profundo, extus infundibuliformi. Operculo — ?

Diam. major 40, minor 30, axis 20 mill.

Hab. ad Pegu.

Remarkable for its dark chestnut and milky-white bands, which recall, by their contrast and decided boundaries, the colouring of *Helix hæmastoma*. A few white dots may be observed near the suture of the antepenultimate whorl. A single specimen has been received for inspection. Perhaps the irregularity of the peristome may not be constant; but it is so conspicuous, that it has not been deemed advisable to omit it as a specific character.

Cyclophorus Scurra, Bens., n. s.

Testa subanguste umbilicata, tenui, globoso-turbinata, nitida, tenuiter striata, striis exilissimis spiralibus, sub lente vix conspicuis, decussata, albida, superne strigis undatis, lineisque spiralibus, subtus fasciis (submediana majori) castaneis picta; spira turbinato-conica, apice acutiusculo, nigrescente; anfractibus 5 convexis, sensim accrescentibus, ultimo rotundato; apertura vix obliqua, circulari, superne leviter angulata; peristomate simplici, tenui, anguste expansiusculo, albedo. Operc. —?

Diam. major 19, minor 16, axis 14 mill.

Hab. ad Pegu.

A pretty little species, with no very marked character, received by Mr. Theobald with the last from the neighbourhood of the town of Pegu. It is a single specimen, like the other.

Mr. Theobald has, during the late rainy season, verified the occurrence of *Pupina imbricifera*, B., at Teria Ghát, on the ascent of the Khasia Hills from Sylhet. In its operculum he finds the corkscrew formation observable in those of the oriental *Megalomastomata* and *Cataulus*. The shell occurs infrequently on dead boughs of trees. A fine *Cyclophorus* which he got at the same place and at Lacát, proves to be *C. Siamensis*, Sowerby, the received habitat of which may consequently, in the absence of direct testimony to its occurrence in Siam, be subject to doubt. Both *Cyclophorus Pearsoni*, B., and its variety *C. Bensoni*, Pfr., have been taken by Mr. Theobald on the southern face of the Khasia range at Lacát and Chaila, and by Capt. Rowlatt at the northern base of the same mountain group, in Assam. If *C. Siamensis* should have an equal range, the more widely known country of Siam may, from the similarity of sound, have been substituted for Assam. Geographical specific names are better avoided in cases where the collector has not verified the alleged habitats personally. A *Helix* inhabiting China has been called *Senegalensis*, and a bivalve, alien to Gangetic India, has been called *Bengalensis*,—the specimen having been merely purchased in the Calcutta Bazaar, which derives its supplies of shells mainly from the boats of the Maldivé Islanders.

Another shell found at Teria Ghát proves to be a dwarf variety of *Pterocyclos Albersi*, Pfr., the habitat of which was previously unknown. It is noted as "not common" by Mr. Theobald, who obtained *Pt. hispidus*, Pearson, abundantly in the same tract, as well as *Hydrocena sarrita*, B. *Cyclophorus zebrinus*, B., was not common at Nancalai.

The late researches of Mr. Theobald, aided in part by Mr. Oldham in Ava, and the Messrs. Blanford in Sikkim, throw

valuable light on the geographical distribution of genera. The tropical island of Borneo, as yet scarcely explored beyond its shores, appears to be a centre of production of the Oriental Cyclostomacea. In it we find representatives of *Cyclophorus*, *Pterocyclos*, *Opisthoporus*, *Cyclotus*, *Leptopoma*, *Diplommatina*, *Alycaeus*, *Rhaphaulus*, *Megalomastoma*, *Hydrocena*, and *Omphalotropis*. To the north-east it sends out an offset to the Philippines, where *Leptopoma* and *Cyclophorus* abound, and *Megalomastoma*, *Cyclotus*, *Pupina* and its allies appear more sparingly. To the south-east, *Cyclophorus*, *Diplommatina*, *Hydrocena*, and *Pupina* proceed along lines extending to the Louisiade Archipelago, New Holland, Lord Howe's Island, and New Zealand. Towards the north-west, with which we are more immediately concerned, the chief branch runs up the Malay Peninsula, first appearing at its extremity, in Singapore, in *Cyclophorus*, *Hydrocena*, and *Pupina*?; at Malacca, in *Cyclophorus*; and at Pulo Pinang and its vicinity, in the same genus, *Leptopoma*, and *Rhaphaulus*. In the Tenasserim Province the family assumes a great development in two or three species of *Cyclophorus*, *Leptopoma*, *Pterocyclos*, *Otopoma**, *Pupina* (2 sp.), *Megalomastoma* (2 sp.), *Rhaphaulus*, *Alycaeus* (2 sp.), and *Hydrocena*. In Pegu and Ava we find eight species of *Cyclophorus*, besides *Leptopoma*, *Pterocyclos*, *Alycaeus* (3 sp.), and *Hydrocena* (2 sp.).

The next point explored to the northward is the Khasia range, where we have seven *Cyclophori*, after deducting a variety and a species which has been erroneously ascribed to the tract; one *Leptopoma*, three *Pterocycli*, two *Diplommatinae*, two *Alycae*, one *Pupina*, and two *Hydrocenæ*. Following the mountain-chains, round the head of the Assam Valley, to the Himalayan ridge, we come upon *Megalomastoma* in Bhotan; and in Sikkim the family puts forth a great effort in the production of four species of *Cyclophorus*, one *Diplommatina*, three *Alycae*, one *Megalomastoma*, and one *Streptaulus*. Passing the (conchologically) unexplored region of Nipal, the Western Himalaya makes an expiring sign in a single *Cyclophorus*, three *Diplommatinae*, and an *Alycaeus*.

On reviewing the above enumeration of genera and districts, I do not find a single species reproduced in a second tract; each has its own peculiar representatives,—a rule which does not hold good with regard to the Helicidae, inasmuch as I find

* *Otopoma Blennus* (Annals, vol. xvii. p. 231) has not the solid structure of *O. clathratulum*, nor the descending last whorl; its aperture is less oblique and larger, and the umbilicus is narrower; the operculum, lately forwarded, proves to be calcareous, somewhat concave, and with five gradually increasing whorls on the exterior side, while the inner surface is rather convex, with a central umbo, and only 1½ rapidly increasing turns.

two small *Helices* of the Western Himalaya reappearing in Sikkim, and a third in the Khasia Hills, together with the little *Pupa plicidens*, of which a solid variety occurs at Cherra. *Helix Castra*, B., of Sikkim also recurs in the Khasia Hills* and in Tenasserim; and *Helix delibrata*, a Teria Ghát species, appears again in Tenasserim, under Gould's synonym of *procumbens*. *Helix rotatoria*, V. d. Busch, keeps up the correspondence of the Burmese forms with the island of Java to the south of the Equator, where *Helix Winteri* represents *H. Huttoni*, Pfr., of the Western Himalaya and Darjiling.

A continuous chain of Cyclostomacea, gradually modified and diminishing in the number of forms, runs from Borneo to the regions where the Himalaya bids farewell to a subtropical climate; but of the following genera, viz. *Diplommatina*, *Alyceus*, *Megalomastoma*, *Rhaphaulus*, *Pupina*, and *Streptaulus*, not a single species has succeeded in crossing the sea, or the barrier of the Gangetic plains, to the central or southern mountains of the Indian Peninsula. The Pupiniform type makes an effort to cross the Bay of Bengal, in *Registoma*, which, in the Nicobars, is associated with *Cataulus*; and the latter genus is fully developed in Ceylon, but does not extend to the Indian Peninsula, where *Cyclophorus*, in varied forms, *Pterocyclos*, *Cyclotus*, and perhaps *Leptopoma*, spread themselves northward. The first two alone attain the banks of the Ganges, at a point within view of the Snowy Peaks which overlook the more productive northern branch of the Malayan stream, along which line, moreover, a *Streptaxis* is found to reach the Khasia region; whereas, by the Cingalese route, the genus does not pass beyond the Nilgherry Mountains in Southern India.

Dr. Pfeiffer has shown himself disposed to include Sowerby's *Cyclostoma Cornu Venatorium* under the Cingalese genus *Aulopoma*, while admitting the absence of the chief character which, apart from the peculiar operculum, distinguishes that genus, viz. the solution of the last whorl. He referred a specimen of *C. Helicinum* to it in the 1st Part of 'Küster's Cyclostomaceen,' and in the 2nd Part figured a shell (plate 49. f. 14-16) under Sowerby's name with doubt. This figure, on comparison with that given in the 'Thesaurus,' cannot be regarded as Sowerby's species. I have always considered that *C. Cornu Venatorium*, S., must be referred to *Cyclophorus*; and a shell found in Ava by Mr. Oldham, agreeing in every respect with that described and figured in the 'Thesaurus,' except in having the apex white,

* The Khasia *Helix plectostoma*, B., common on rocks and trees at Teria Ghát, has been found by the Messrs. Blanford at Darjiling.

appears to leave no doubt on the subject. An immature specimen before me might be supposed to have furnished the engraver with his model; and a larger and more solid specimen, with the thickened peristome fully developed, at once stamps the form as belonging to *Cyclophorus*. The operculum has not been seen. The attention of future collectors in Ava should be particularly directed to the capture of a living example.

Cannes, 15th January 1857.

XVII.—*Notice of a marked variety of Patella vulgata (proposed to be named var. intermedia), found in Guernsey and Jersey (from information communicated by Dr. KNAPP). By ANDREW MURRAY, Edinburgh.*

THE shell in question was collected by Dr. Knapp at St. Owen's Bay in Jersey, and also near St. Samson's in Guernsey. He has never found it either in England or Scotland. He discovered it in both the above islands, along with and in the same localities as *vulgata* and *athletica*; but *athletica* was always nearer low-water mark, and very often in pools submerged, while the present shell was, like *vulgata*, almost invariably nearer high-water mark.

Various differences in the characters of the shells are also to be noted. The animal of the present shell is always black or dark-coloured, while that of *athletica* is white, with a yellow or orange tint; and here Dr. Knapp wishes me to correct a misapprehension into which the late Prof. Edward Forbes had fallen regarding some information given him on this point by Dr. Knapp, and which he has recorded in his 'British Mollusca.' In speaking of the colour of the animal of *athletica*, he states it to be always pale-coloured; but he adds, in a note, "Dr. Knapp, however, has sent us specimens of the China Limpet (*athletica*) from both Guernsey and Jersey, with the note that 'the animal is always black or dark-coloured.'" Now, this is entirely a misapprehension of Dr. Knapp's communication to Prof. Forbes, or, at all events, of what he intended to communicate. The mollusk whose animal he spoke of as being always dark, was this intermediate variety or species. It, as already mentioned, he found to be always dark; but he found *athletica* invariably pale. Prof. Forbes therefore must either have assumed that Dr. Knapp was speaking of *athletica*, or, what appears to me more probable, Dr. Knapp having sent him specimens of this shell with his remarks upon it, Prof. Forbes had determined it in his own mind to be *athletica*, and had thereupon imported the remarks upon it into his description of that species.

On comparing the two shells, however, there are other differences, besides its habitat and the colour of the animal, which seem inconsistent with the idea of its being *athletica*. Its shell never reaches the size of that species. It is rounder in shape. It wants the china-like texture in the interior, and its colour there, instead of being whitish, is yellowish cream-colour or orange-brown: the exterior also is much darker. It wants the thickness and solidity of *athletica*, or full-grown specimens of *vulgata*; and the substance of the shell itself, instead of being dirty white, is more or less tinged with yellow and brown,—although I differ from Prof. Forbes in thinking this a character worthy of much reliance. Further, although the ribs have the prominence and aspect of those of *athletica*, they are more numerous, and want the tooth-like scales arranged in successive rows, given as an essential character of the latter by Forbes and Hanley. The dark colour of the interstitial spaces also is not blotched, as in *athletica*, but uniformly continued from the base to nearly the apex, which is generally orange-yellow, although sometimes whitish. I may add, that the empirical character or general appearance of the shell (which is a kind of testimony by no means devoid of weight) speaks strongly in favour of its being distinct from *athletica*. The two shells are so different in their appearance on the rocks, that even a person wholly unacquainted with conchology could, after they had once been pointed out to him, readily and correctly say to which kind every new specimen that was seen belonged,—a test which was more than once successfully applied by Dr. Knapp.

I think therefore, on the above grounds, we may assume that it cannot be referred to *athletica*. It would appear to come nearer *vulgata*, although there are differences which almost appear specific. It certainly has more resemblance to some of the forms of young shells of *vulgata* than to any other species; but this shell, although no larger than these young shells, is full-grown. The animal of this shell is much darker than that of *vulgata*, which is usually a more or less deep slate-colour or dirty white. The shell too is almost invariably depressed, and never assumes the large, high, conical form of the full-grown *vulgata*. It has the rich brown markings of *athletica* on the exterior, and a well-defined dark-brown line running up the interstitial spaces. The ribs are particularly prominent, and it has (though in a less degree) the jagged and denticulated margin characteristic of *athletica*. The colour of the tops of the ribs both in *athletica* and the present shell is white, particularly marked when the shell is cleaned, which is not the case with *vulgata*. In the foregoing differences we see that it borrows some of its characters from *athletica*, and some from *vulgata*;

but there remains one which is very characteristic of it, and which is peculiar to itself, viz. its rich-coloured spatula, generally brownish-orange or yellowish-orange, rarely cream-coloured, reminding one of the glowing interior of some of the South Sea species. This character seems constant, and is readily recognizable: in some rare cases the colour is comparatively pale, but in the palest there is always a richness both of colour and texture, which shows as great a difference between it and the others as there is between cream and skimmed milk.

Dr. Knapp would appear not to have been the only person whom the peculiar characteristics of this shell have struck, for Forbes and Hanley mention that Mr. Alder states "that in some parts of England he had seen this Limpet (*athletica*) range much higher up between tide-marks, and had noticed on the southern coasts an intermediate form between this and *vulgata*, which looked very like a hybrid."

Whether Dr. Knapp's shell is the species which looked to Mr. Alder like a hybrid, I do not know, but think it very probable that it may be. If it is so, I do not imagine that by comparing it to a hybrid, Mr. Alder meant to propound that it *was* a hybrid, but merely that it possessed characters peculiar to both its allies; and so far he would be right. But a careful examination of a sufficient series of the different forms, &c. assumed by the species of *Patella* will not, I think, warrant us in holding it to be more than a variety. The only strongly-marked features peculiar to itself depend upon colour; and although colour, when associated with other pretty constant features, may be admitted as a character in some genera, we can scarcely admit it as such in *Patella*, where the variation of form and colour is very great, considering the restricted scope the simplicity of its outline affords. If it is not a distinct species, then the proper species to which to refer it as a variety is undoubtedly *vulgata*. A very marked and easily recognizable variety it certainly is; but, as Dr. Greville has suggested to me, there are other varieties not much less marked; for instance, the high, conical, peaked form, characteristic of the species found at Inverary, and still more so the deep leaden-coloured variety, which invariably exhibits a margin almost black. These to my mind are not so striking as the present, and, moreover, are varieties which are not confined, as I believe this to be, to Guernsey and Jersey, and possibly the south of England. Still the existence of so great variations renders the possibility of others still greater not unlikely, and I therefore have, on the whole, come to be of opinion that the shell in question is merely a variety of the *Patella vulgata*, which, for convenience of future reference, Dr. Knapp proposes to call *Patella vulgata* var. *intermedia*.

XVIII.—On the Structure of the Shell of *Rhynchonella Geinitziana*. By WILLIAM B. CARPENTER, M.D., F.R.S.*To the Editors of the Annals and Magazine of Natural History.*

GENTLEMEN,

Feb. 17, 1857.

I lose no time in communicating to you the result of an examination which I have this day been enabled to make, of the shell of *Rhynchonella Geinitziana*; the existence of perforations in which, "as distinct and regular as those of any Terebratulidæ," was positively affirmed by Prof. King, in your pages, about a year ago (A. N. H. vol. xvii. p. 334). In my comments upon Prof. King's statements as to this and other points relating to the shell-structure of Brachiopoda, I remarked (p. 504) that I had seen enough to satisfy me that Prof. King had some grounds for this assertion, but *not* enough to satisfy me that the perforations extend through the entire thickness of the shell, and are therefore the equivalents of those of Terebratulidæ. In order to determine this question, specimens are required in which the shell has neither been reduced by abrasion on its external surface, nor has had its original texture obscured by metamorphic action. I had strong reason to believe that in one or both of these particulars the specimens at my command were faulty, and I therefore abstained from committing myself to a positive conclusion.

The sequel has proved the justice of my caution. Mr. Davidson has taken the trouble to send all the way to Russia for the specimens of this rare shell contained in the collection of the Corps des Mines of St. Petersburg; and these have been kindly forwarded by General Von Helmersen, the head of that establishment, for the express purpose of being examined by me.

From among the four specimens thus placed before me (which are guaranteed by Mr. Davidson to be specifically identical with the German specimens examined by Prof. King), I selected the one which presented on its exterior the least indication of abrasion or metamorphic action; from this I carefully removed some shreds large enough for microscopic determination; and I am now in a condition to assert positively, that portions of the *external* laminae of *Rhynchonella Geinitziana*, in which the peculiar texture of the shell is perfectly preserved, *do not show the least evidence of perforations*,—the so-called perforations of Prof. King being therefore only pits upon the internal surface of the shell, analogous to those which present themselves upon the external surface of *Porambonites* and *Trematis*.

I shall be happy to submit this preparation to the inspection of any one who may feel an interest in the question, and remain,

Gentlemen, your obedient Servant,

WILLIAM B. CARPENTER.

XIX.—On the Organization of the Infusoria, especially the Vorticellæ. By Dr. C. F. J. LACHMANN.

[Concluded from page 128.]

IN the Infusoria we have found the alimentary apparatus to be a large nutritive or stomachal cavity filled with chyme, and furnished with a mouth and anus. In the *Vorticellinæ* we have seen an œsophagus, ciliated internally, depending from the mouth, and widening below into the pharynx. The internally ciliated œsophagus occurs also in many other Infusoria, but its dilatation into a pharynx is to be detected in no other family.

The œsophagus (*Schlund*), beset internally with fine cilia, and terminating below by an oblique truncation without dilating into a pharynx, is most distinctly seen in the *Paramecia* and the allied genera. In these animals, which are furnished with uniform fine cilia, sometimes all over and sometimes only upon a considerable portion of the body, and in which there is no row of stronger cilia leading to the mouth, after a morsel has been passed from the œsophagus into the alimentary cavity, we see the latter distinctly with a somewhat oblique termination; a little drop of water is then soon whirled through its lower extremity, against the tenacious fluid chyme-mass by which it is limited; the drop gradually becomes larger, and is completely surrounded by the chyme, the lower extremity of the œsophagus being applied to it only on one side. When the morsel thus formed has attained a certain size, which is not always the same, it is passed into the chyme-mass, where it then behaves in the same way as the fusiform masses of the *Vorticellinæ*, and also soon participates in the rotation of the chyme. In these animals also, as in the *Vorticellinæ* and all Infusoria furnished with a ciliated œsophagus, the water and food, instead of being united into drops or morsels, may be mixed at once with the chyme, evidently from an altered condition of the latter. In these Infusoria (Ehrenberg's *Colpodea*, with the exception of the species of *Amphileptus* and *Uroleptus**, the *Cyclidina* of Ehrenberg and

* With Focke I refer *Loxodes Bursaria*, Ehrbg., to *Paramecium*, as the situation of the anus at the hinder extremity of the body does not appear to me sufficient for a generic separation of this animal from the closely allied *Paramecia*, the anus in *Paramecium Colpoda* being placed very near the hinder extremity, which is still more strikingly the case in a new colourless *Paramecium* very nearly related to the colourless *P. Bursaria*. I do not, however, with Perty, think it necessary to revive O. F. Müller's name of *Paramecium versutum*, as there is scarcely ever any certainty in the synonymy previous to Ehrenberg; and I think therefore that we should never again introduce an older specific name for an Infusorium, if it has a name given to it by Ehrenberg, even when it is not improbable

Glaucoma) the anus is situated on the ventral surface near the posterior extremity, or at the posterior extremity itself. Many of these Infusoria possess in front of the mouth a peculiar apparatus, consisting of bristles or a folded membrane; which of these is the case, it is difficult to decide (*Paramecium Chrysalis*, Ehrbg. = *Pleuronema*, Duj., *Cyclidium*, Ehrbg., *Alyscum*, Duj., Perty's *Aphthonia*); in some the margins of the buccal orifice appear to be produced into two valves, which are in constant motion (*Glaucoma*, *Cyclidium margaritaceum*, Ehrbg. = *Cinetochilum margaritaceum*, Perty, the family of the *Cinetochilinae* of Perty).

The alimentary apparatus in many other Infusoria is just the same as in these (*Colpoda*, &c.), except that a particular series of cilia, distinguished from those covering the rest of the body by their greater strength and length, leads to the mouth (as in the *Bursariae*, *Spirostomum*, and the *Stentorinae*). These cilia then form a curved line, usually open towards the right, or, as in *Spirostomum* and the *Stentorinae*, a prolongation of a line of this kind, namely a spiral turning towards the left (Pl. IX. figs. 6-8 *b, f*). In the *Bursariae* and *Spirostomum* the anus is placed at the posterior extremity of the body; in the *Stentorinae* (figs. 6-8 *e*), on the back, close beneath the series of cilia*.

that he may have overlooked an older name. This maxim appears to me to be equally justifiable with that of preferring the specific names of Linnæus to older ones in other departments of the animal and vegetable kingdoms, as otherwise we must get into an inextricable confusion of names, different authors frequently referring the older specific names to very different species.

* I have already characterized the new genus *Chaetospira* belonging to the *Stentorinae*. I am at present acquainted with two species of this genus from the fresh waters near Berlin. One of these, *C. Mülleri*, Lachm. (figs. 6 & 7), is slender; the first cilia (*b*) of the series of cilia are somewhat, but not remarkably, longer and stronger than the rest: when rolled up, the process bearing the series of cilia forms more than one turn of the spiral. The animal inhabits flask-shaped horny sheaths, which I have hitherto found only in the open cells of torn leaves of *Lemna trisulca*. The second species, *C. mucicola*, Lachm., inhabits mucous tubes; it is shorter and more compressed; the rolled-up process does not form a complete turn of the spiral; the first cilia are considerably longer than the rest, the first one especially being nearly twice as long as most of the others. Like all the *Stentorinae*, both species are beset all over with fine cilia; but I cannot yet state with certainty whether *C. Mülleri*, like *C. mucicola* and *Stentor polymorphus*, possesses longer hairs between the cilia. It is possible that the free-swimming *Stichotricha secunda* of Perty, which he arranges with the *Oxytrichinae*, is allied to my *Chaetospira*; his figure, however, is very inexact, and might perhaps represent a *Loxodes* or *Amphileptus fasciola*; and as he does not describe the position of the anus, which he never figures, any more than the contractile vesicle and the nucleus, I do not venture to place his *Stichotricha* with the *Stentorinae*. If it should turn out that it belongs to that family, it must be placed beside the analogous sheath-inhabiting *Chaetospira*, as a genus not inhabiting a sheath.

In Ehrenberg's families of the *Oxytrichinæ*, *Euploteæ*, and *Aspidiscinæ*, as in the preceding, we also meet with an internally ciliated œsophagus (fig. 10 *h*), and a curved line open towards the right, composed of strong cilia (fig. 10 *b*, *f*) leading to the mouth (fig. 10 *f*). But besides the cilia of the surface of the body, or still more frequently without these, we find peculiar and more powerful organs of motion, the number and arrangement of which may serve for the distinction of the species and genera. These consist partly of very thick cilia placed in rows, which might be called ciliary bristles (*Oxytrichinæ*), partly of peculiarly grouped powerful processes, very thick at the base, and serving as feet, which were denominated *uncini* by Ehrenberg* (in all three families); and besides these, the thin setiform processes, distinctly articulated at the base, and called *styli* by Ehrenberg, occur at the posterior extremity of some *Oxytrichinæ* and *Euploteæ*†. The anus in these animals is situated in the posterior part of the ventral surface (fig. 10 *e*). The internally ciliated œsophagus, which in the preceding always formed an open tube, is often collapsed in these at its inner extremity, and thus forms a transition to the œsophagus of the following groups.

Many Infusoria have a completely collapsed œsophagus—which, as forming a tube distinct from the parenchyma of the body, and hanging freely in the alimentary cavity, is perhaps entirely wanting in some species; at least I have hitherto been unable to detect it in *Amphileptus*, most species of *Trachelius*, *Enchelys*, *Coleps* and *Trachelocerca*, in which it only appeared to be a canal through the parenchyma of the body,—and these are generally incapable of forming roundish morsels like the species hitherto under consideration; but they usually swallow larger particles, which then pass separately into the cavity of the body, often even without being accompanied by water. It is very difficult to determine whether the œsophagus of these animals is furnished internally with cilia. In some, such as *Coleps*, this almost appears to be the case; these swim to any slimy mass, such as a deliquescent Infusorium, press the anterior extremity of the body against it, and open the mouth and œsophagus, which are usually closed, so as to form a wide canal; the mass lying before the *Coleps* then passes through

* Of these, the anterior serve for the actual creeping or climbing; the posterior ones might be suitably denominated *trailing feet*, as they are generally trailed along behind the animal, and only employed occasionally in giving a subsequent push: these are cleft at the end in some species, as, for example, in *Euplotes patella*.

† That one of these styles, in *Euplotes patella*, bears setiform branches, has been already observed.

this canal into the interior of its body, apparently without any swallowing movements on its part, so that it can hardly be driven in, except by ciliary action. In others, on the contrary, the cilia of the œsophagus appear to be wanting, as in *Amphileptus*, *Enchelys*, *Trachelius*; these perform regular movements of deglutition, in order to overcome their prey, which usually consists of Infusoria of tolerable size; they push themselves, as it were, with swallowing motions, like the Snakes, over their prey, so that they can very rarely be fed with colour, and this never forms stomach-like morsels, except when it is contained in this form in the Infusoria devoured. The mouth in these animals is sometimes placed at the anterior extremity (*Coleps*, *Enchelys*), sometimes not (*Trachelius*, *Amphileptus*); the anus is sometimes situated posteriorly, and sometimes not.

This group of Infusoria is approached by those with peculiar bacillar thickenings, or cel-pot-like teeth (Ehrenberg) in the œsophagus, which is also collapsed. In these the œsophagus usually extends in the form of a collapsed tube far beyond this bacillar apparatus; in *Chilodon cucullulus*, for example, nearly to the posterior extremity of the animal. The mouth, which is not unfrequently protrusible, is situated sometimes at the anterior extremity of the animal (*Prorodon*), sometimes not (*Chilodon*, *Nassula*, *Liosiphon*, *Trachelius Ovum**). The anus is generally placed at the posterior extremity of the animal, but in some cases on the ventral surface near the hinder end (*Chilodon cucullulus*, in which it is nearly on the right margin of the body).

In the greater part of the Infusoria furnished with flagella, the reception of food appears to take place in the same way as in the last-mentioned groups of ciliated Infusoria. Although Ehrenberg states that he saw the reception of food by *Monadine* and *Cryptomonadine*, and figures coloured particles in animals belonging to these families, this was denied by many, who either thought that they were to be transferred to the vegetable kingdom as unicellular plants, or regarded them as astomatous animals. Cohn† was the first to re-establish the eating of these animals, and I have also succeeded in seeing it in many of them; I have not only seen coloured particles in the interior of the body, of which, from the minuteness of the object, one might always have remained in doubt as to whether they were really contained in its interior, but I have also twice observed *Monadine* which contained a small *Bacillaria*, the excretion of which in the vicinity of the posterior extremity taking place soon

* For the knowledge of the bacillar apparatus in the latter, I am indebted to Dr. Lieberkühn.

† *Entwicklungsgeschichte der mikroskopischen Algen und Pilze*, p. 62 (Nova Acta Acad. C. L. vol. xxiv. pt. i. p. 162).

afterwards, also made me consider the existence of an anus probable. Last summer, Professor J. Müller, in company with M. E. Claparède and myself, observed great numbers of an animalcule, which was probably *Bodo grandis*, Ehrbg., but might also have been an *Astasia*, and which devoured *Vibriones* of two to four times its own length: in this way the animalcules acquired the most extraordinary forms, and the mouth was close to the insertion of the flagellum. With some attention, one or more contractile vesicles may be detected in all transparent animals of this family; of the more opaque species I was also able to observe this and its contractions in the anterior part of the body in *Chilomonas*, *Paramecium* and *Cryptomonas ovata*.

The *Volvocina*, *Astasiæ* and *Dinobryina* must apparently be arranged close to these animals, or at least those which possess a contractile space, although they have not yet been observed feeding. That they really receive no nourishment into an alimentary cavity, is certainly not proved. In certain cases Perty states that he has found very fine vegetable filaments in *Euglenæ*; but even if we do not regard this statement as sufficient for the observation of the eating, yet we have very recently ascertained modes of taking nourishment by Infusoria which might possibly occur also in the *Volvocina*, &c., when it would certainly not appear by any means wonderful that they should only be discovered at so late a period. Has not Claparède* only just made us exactly acquainted with the process of feeding in *Actinophrys*? If a similar mode of feeding, by the reception of the food in a process suddenly thrown out, also takes place in the above-mentioned creatures, it would be rarely observable in them, and it would only be by a happy chance that we should perceive the short moment of feeding; and then, if the nourishment consisted of small monads which are easily liquefied, we should not recognize them as such in the body of the animal. The observation would be equally rare and difficult if these animals, like the *Acinetæ* (*vide infra*), extracted the fluids of other animals by means of retractile suckers; and this is the less improbable, as Dr. Wagener has communicated to the Society of Naturalists of Berlin† an observation of Dr. Lieberkühn, who saw a flagellated Infusorium swim up to another, attach itself to this by a process projecting from one end, and thus suck out its contents. But even though the feeding of these creatures has not yet been seen‡, I think we must, from analogy, refer them to the animal kingdom.

* Ueber *Actinophrys Eichhornii*, Müller's Archiv, 1854, p. 54; translated in the Annals, vol. xv. 1855, pp. 211 & 285.

† In the July Meeting, 1855.

‡ It is probable that a mouth will be discovered in all aquatic Infusoria,

A contractile space, such as I have now certainly seen in a great number of the above-mentioned forms*, has not yet been observed in any vegetable cell, or in the spore of an undoubted plant: endeavours specially directed to this object have hitherto been always futile. For this reason I believe, with A. Schneider†, that we must associate these creatures which are furnished with a contractile space with those which present the greatest external resemblances to them, and also possess a contractile space, namely the *Monadinae*, and therefore with the animal Infusoria, as long as no contractile space is found in indubitable vegetable cells.

In the *Peridinia*, which are furnished with flagella and cilia, no contractile space has hitherto been found; but, on the other hand, in company with E. Claparède, I made some observations on the Norwegian coast upon *Peridinium tripus*‡, *furca*, and *fusus*, which promise, if pursued further, to make us acquainted with the mode of reception of food. From the point of insertion of the flagellum, on one side of the large notch, in the upper part of the row of cilia, a clear canal passes into the body of the animal, and dilates at the extremity to form a cavity of variable diameter. The flagellum is often seen to contract rapidly into a spiral form, and apparently disappear; and not unfrequently we may then succeed in perceiving that it is jerked back into the above-mentioned cavity, from which it soon returns into its previous position. Now it certainly appears worth while to see whether small particles of food are not carried into the cavity by this jerking-in of the flagellum.

The dispute as to the position of the *Bacillariae* and *Closterinae*,

and that only a number of the Entozootic species (the *Opalinae*) will prove to be truly astomatous. *Bursaria cordiformis*, Ehrbg., and *B. intestinalis*, Ehrbg., however, are erroneously referred to the *Opalinae*, as they possess a mouth.

* Cohn does not consider his observation of the contractile space in *Chlamydomonas* and *Gonium* as sufficient to justify our regarding these creatures as animals. Besides these, E. Claparède and I observed the contractile space also in *Syncrypta Volvox*, and then in *Volvox*, in which its position is quite correctly described by Busk (Quart. Journ. of Micr. Science, i. 1853). I can completely confirm Focke's observation of the contractile space in *Dinobryon Sertularia*, and also found one in *Euglena viridis*. Claparède saw it in *Euglena Pleuronectes* and *E. Acus*. The detection of the contractile spaces in the *Euglenae* is rendered particularly difficult, not only by the mobility of the animal, but also by the circumstance that it lies directly over or close to the clear spot, indicated by Ehrenberg as a ganglion.

† Muller's Archiv, 1854, p. 203.

‡ Numerous observations and measurements of transition forms made by ourselves, as well as a number of drawings most kindly communicated to us by Professor Boek of Christiania, seem to prove that *P. tripus* and *P. megaceros* are not specifically distinct.

or the *Desmidiaceæ* and *Diatomeæ*, cannot certainly yet be regarded as decided. It is well known that a contractile vesicle has not as yet been discovered in them; their power of motion, their fissiparity, and the discovery by Focke of cilia in the interior of the *Closteria**, cannot settle the dispute. The retractile pseudopodia described by Ehrenberg have not been detected by other observers: the presence of colour in creatures of this group, proved by Ehrenberg, has been supposed capable of explanation otherwise than by the eating of coloured particles, as unfortunately the act of feeding was not observed, and the accumulation of colour in particular places, which are then regarded as the nuclei of these unicellular plants, appears to find an analogue in the discovery of Hartig†, that the cell-nuclei of all plants acquire colour more strongly than their other parts.

A peculiar mode of feeding, which has hitherto always been misunderstood, still remains to be mentioned. It has long been known (since the time of O. F. Müller) that other Infusoria often remain adhering to the tentaculiform rays of the *Acinetæ*, which are usually thickened at the extremity; and that, when they do not soon succeed in freeing themselves, they die. Even O. F. Müller supposed in consequence that the *Acinetæ* sucked out the contents of these animals, but he says nothing of the mode in which this is effected, and indeed could not observe it with his imperfect instruments. Ehrenberg believed that the captured animals were brought close to a mouth situated between the tufts of rays, and sucked out by this. Stein and Perty denied the existence of a mouth in these animals, and grouped them with the *Actinophrydes*; the former, again, distinguished the eating *Actinophrydes* (the true species of the genus *Actinophrys*, *A. Eichhornii* and *Sol*, with *difformis*, Ehrbg. and *oculata*, Stein) and those which did not eat (non-pedunculated individuals of *Podophrya fixa*, and therefore true *Acinetina*‡). The Infusoria which come in contact with the rays of the latter are said to die upon them, and then to become dissolved, when the fluid thus produced is taken up by the rays by endosmose. According to Perty, the death of the Infusoria is caused by an impalement on the extremely fine filaments of the *Acinetæ* and *Actinophrys*. Both these ideas were equally paradoxical and incorrect: the true mode of feeding, as may be seen without much difficulty

* Physiologische Studien, Heft 1.

† Communicated to the Naturforscherversammlung in Göttingen, 1854.

‡ To these, and indeed to the same genus as *Podophrya fixa*, belongs the *Actinophrys ovata* of Weisse, which I have had the opportunity of observing in the neighbourhood of Berlin.

in the larger species, especially the *Acineta ferrum-equinum*, Ehrbg.*, is as follows :—

When an Infusorium touches the button-like or plate-like dilated apex of the ray of an *Acineta*, it usually remains adhering to it; the apex of the ray becomes still more extended in the form of a plate, so as to constitute a sucking disk, and the ray becomes thicker and shorter; at the same time other rays make grasping movements, and endeavour to attach their extremities, which are becoming dilated into sucking-disks, to the captured prey. If the latter does not soon succeed in making its escape by great exertions, by which the rays of the *Acineta* are often greatly disarranged and injured, the *Acineta* begins to suck out its contents. Each ray is a sucking proboscis, and we soon see that a current of chyme-particles runs from the alimentary cavity of the captured Infusorium into the body of the *Acineta*, through the axis of the rays which, after seizing the prey, have become shortened and thickened. In the body of the *Acineta* the chyme-particles still run at first in a slender row, but afterwards they collect in a drop (fig. 14), which, although drops are also formed in the chyme of the *Acineta* by other suckers, soon becomes amalgamated with these. When a considerable quantity of the chyme of the captured animal has passed over into the body of the *Acineta*, a remarkable change gradually takes place in its appearance: if it was previously pale, nearly transparent, and only very finely granulated (fig. 14), larger, dark globules, resembling fat-drops, now make their appearance here and there; and these soon increase, so that the body, which at the same time of course increases in thickness, acquires a coarsely granular aspect, and becomes opaque (fig. 15). The globules or drops which make their appearance can only be formed in the body of the *Acineta*, as they are far larger than the chyme-particles which are seen flowing through the sucker†. The animal whose contents are thus sucked out, gradually collapses and dies; many become liquefied when only a little of the chyme is extracted from them, others still live for a long time; in large animals, such as *Stylonychia Mytilus*, *Paramecium Aurelia*, &c., the sucking often continues for several hours. Whether the *Acinetina* possess an anus, or in what way they again throw off effete matters, has not yet been ascertained.

With regard to the structure, and especially the nutritive apparatus of the Rhizopoda (including besides the Foraminifera

* This has subsequently been described by Weisse as *Acineta oothurnata*, and by Stein as the diadem-like *Acineta*.

† These alterations in the appearance of the body occur also in other Infusoria when they have devoured animals (Infusoria).

of D'Orbigny, or the Polythalamia, the *Amæbeæ*, the *Arcellinæ*, and the *Actinophrydes**), I can add nothing fresh to the statements of the most recent authors (especially those of Max Schultze upon the Polythalamia and of Claparède upon *Actinophrys*†). I have seen the flowing of the granules in the processes of the Polythalamia and in *Actinophrys*, their transfer from one process into another which was amalgamated with it in the Polythalamia, and the eating and conjugation of *Actinophrys*, as described by the above-mentioned authors. As we know scarcely anything of their reproduction, I shall not refer to it in what follows.

Besides the skin and the alimentary apparatus, two other organs remain to be mentioned, as being common to all Infusoria, both of which Ehrenberg believed were to be reckoned parts of the male sexual apparatus. To regard the globules considered by Ehrenberg as ova (Perty's "Blastien") as being really such, in the present state of our knowledge of the Infusoria, is unnecessary, as the exclusion of brood from them has never been observed, and the theoretical necessity which induced that naturalist to give them this interpretation is fulfilled by the discovery of very small embryos formed in a different manner. (To these we shall refer hereafter.) The globules regarded as ova and as "Blastien," are partly the roundish corpuscles, sometimes coloured, sometimes colourless (already mentioned), which occur in the parenchyma of some Infusoria; partly chyme-particles, and lastly, in part the oil-drop-like globules which are seen to make their appearance in the Infusoria after the reception of animal food‡.

That the interpretation proposed by Ehrenberg for the two organs still to be taken into consideration, namely the contractile space and the glanduliform body, is destitute of any certain foundation, and exceedingly improbable, has already been sufficiently demonstrated by others; but yet no unity of opinion has been arrived at with regard to their true signification.

The contractile space (seminal vesicle, according to Ehrenberg) is regarded by most of the recent authors, except O. Schmidt and E. Claparède, in accordance with Dujardin's example, as a

* Which the *Acanthometræ*, and probably also other creatures possessing a siliceous skeleton, and the position of which is doubtful (the *Polycystinæ* of Ehrenberg, and perhaps the Sponges and *Thalassicollæ*), appear to approach in their structure, according to the most recent observations of Claparède (Monatsbericht der Akad. der Wiss. zu Berlin, 1855, p. 674), which I was so fortunate as to be enabled to repeat and confirm immediately after they were made.

† Translated in the *Annals*, vol. xv.

‡ Even the yellow ova of *Bursaria flava*, Ehrbg., appear to be coloured oil-drops.

cavity destitute of proper walls (vacuole), which is sometimes supposed to form the analogue of a heart*, and sometimes that of an excretory† or respiratory‡ water-vascular system. In order to be able to judge of these views, we must first of all examine rather closely into the behaviour of the contractile space, and for this purpose those Infusoria in which processes or branches of the vesicle can be detected, appear to be particularly important.

Radiating branches of the contractile spaces were first discovered by Ehrenberg in *Paramecium Aurelia* and some other Infusoria. When the contractile space is full and wide open, the rays can only be observed as fine lines, or, when the light is not good, are entirely imperceptible; by the sudden contraction of the space, however, they instantly swell into a pyriform commencement close to the position of the contractile vesicle which has disappeared. With favourable illumination, when the animals possess the proper degree of transparency, the rays may be traced in *Paramecium Aurelia* across the half of the animal, and we may sometimes perceive a bifurcation of one or other of them. During the slow re-appearance of the contractile space, the rays gradually decrease, and they have almost entirely disappeared, or become reduced to fine lines, when the vesicle has attained its full extension. These rays, as well as the contractile spaces, lie, as in all Infusoria, close under the skin ("cuticula" of Cohn), in the parenchyma of the body ("cortical layer" or "cell-membrane" of Cohn).

In many *Vorticella* we also find processes going off from the contractile vesicle (Ehrenberg even states that he has frequently seen the contractile vesicle of *Carchesium polypinum* lobate or almost radiate); of these I have been able to trace one particularly, in *V. nebulifera*, *campanula* and *Carchesium polypinum*, up to close beneath the skin of the ciliary disk; this, when seen from above, exhibited a longish section (fig. 3 k). From this a fine branch appears to run, on the upper wall of the vestibulum, transversely across this to the other side; at least I have seen a thin process hanging down like a short curtain into the vestibulum from the side turned towards the ciliary disk (in fig. 8 it is represented by the broad dotted line which runs transversely across the vestibulum from k), which swelled up when the above-mentioned process became enlarged in consequence of the contraction of the vesicle.

In *Dendrosoma radians*, Ehrbg., a fine vessel runs through

* Wiegmann, Archiv, 1835, i. p. 12; Von Siebold, Vergl. Anat.

† Bergmann and Leuckart, Vergl. Anat. pp. 184 and 214.

‡ O. Schmidt, who, however, admits the existence of walls to the vesicle. Forriep's Notizen, 1849, p. 5; Vergl. Anat. p. 220.

the whole length of the body, and sends branches into its ramifications: it is furnished with a number of contractile spaces, partly in the stem and partly in the branches.

The processes of the contractile space are seen with remarkable distinctness in the large *Stentor polymorphus* (including *S. Roeselii* and *Mülleri*), in which a very considerable portion of a vascular system may be recognized. The large contractile space lies a little to the left of the œsophagus, near the plane of the ciliary disk (fig. 8 k). From it a longitudinal vessel runs to the posterior extremity of the animal, and an annular vessel round the ciliary disk (*Stirn*) close under its series of cilia. Both these are visible even during the expansion of the contractile vesicle, but swell up suddenly like the vessels of the above-mentioned Infusoria during its contraction: at this time the longitudinal vessel usually exhibits considerable dilatations, which, when superficially examined, may easily be taken for independent, disunited cavities (vacuoles). (See figs. 8 and 9; the latter figure shows a diagrammatic section of a part of the posterior extremity of *Stentor*, in the parenchyma of which the dilatations of the longitudinal vessel are seen on the left side.) The annular vessel exhibits a more uniform lumen; only two roundish dilatations make their appearance in it, one close to the anus on the dorsal side of the animal, and the other close to the œsophagus on the ventral surface (fig. 8 o o). Both vessels gradually decrease during the reappearance of the contractile vesicle, apparently without any contraction of their own, in the same way as the vessels of the *Paramecia*. The longitudinal vessel of the *Stentors* and a similar one in *Spirostomum ambiguum* were first described by Von Siebold*, whilst their existence has been erroneously denied by Eckhardt†.

As we thus find a vascular system in the *Stentors*‡, and in other Infusoria recognize the parts lying nearest to the centre (the contractile space), sometimes easily and sometimes with difficulty, we may certainly conclude that such a system exists in all Infusoria which possess a contractile space, even when no branches have been detected running out from this. That this system does not merely consist of accidental chasms in the parenchyma of the body (vacuoles of Dujardin), is apparent from its regularity. When it is asserted, in proof of the inconstancy of these vacuoles, that exactly similar ones frequently make their appearance in other parts of the body, this appears to me

* Vergleichende Anatomie, p. 21.

† Wiegmann's Archiv, 1846, p. 237.

‡ In opposition to the opinion that this is a system of seminal canals, the existence of the annular vessel in *Stentor* may also be taken, in addition to the reasons brought forward by other authors.

to arise from very different things being confounded together. The swelling dilatations of existing vessels are certainly often regarded as such vacuoles, without its being remembered that these dilatations always gradually decrease again, whilst the true vascular centres, the contractile spaces, always diminish suddenly in healthy animals. Moreover, in diseased Infusoria, an exudation of a fluid, with which the parenchyma is normally imbued, appears to take place from it even into the cavity of the body, and perhaps into chasms of the parenchyma, as we often see it take place in Infusoria, and many other low Invertebrate animals, on the surface of the body. These sarcode-drops appear to be incapable of ever being again absorbed, but their formation always appears to lead, although slowly, to the death of the animal.

Although we may now assert positively that the contractile space is the centre of a vascular system, which does not consist of chasms formed in the parenchyma by its accidental separation, another and more difficult question concerning its nature remains to be cleared up, namely, whether the vessels and the contractile space possess proper walls, or whether they are only regular and constant chasms in the parenchyma, and whether the contractile space is or is not a vesicle. The mode of contraction, which differs from the other contractile phenomena of the parenchyma of the body, appears to speak decidedly in favour of the vesicular nature of the contractile space. The circumstance that, before its complete expansion, it frequently appears to be divided into two or three, is not opposed to this, as a vesicle may very well be constricted into two or more parts by the partial contraction of annular portions, or by strictures. Some other facts appear to be in favour of the vesicular nature of the contractile space, such as the phenomenon presented by *Spirostomum ambiguum*, already referred to, in which balls of excrement pass to the anus between the contractile space and the outer skin of the animal, and, although often arching the wall of the contractile space into a semiglobular form, yet never break through into it. In *Actinophrys*, the supposition that there is a membranous boundary at least on the outside of the contractile vesicle, can hardly be rejected, as its wall, which is situated on the outermost surface of the body, must burst at the moment of greatest expansion, if it were only composed of the gelatinous parenchyma of the body*.

The behaviour of the contractile vesicle in *Actinophrys*, also, hardly allows us to suppose that it has an opening outwardly;

* See Frey, *Hautbedeckungen der wirbellosen Thiere*; Von Siebold, *Vergl. Anat.*; and especially Claparède, *Müller's Archiv*, 1854, p. 417, translated in the *Annals*, *loc. cit.*

nor have I ever been able, in other Infusoria, to confirm O. Schmidt's assertion* that the contractile vesicle opens externally. In many Infusoria we see one or more pale spots upon the contractile vesicle, which may easily be taken for orifices, but, on closer examination, prove to be only thin spots in the parenchyma of the body and the skin, by which the action of the external water upon the contents of the vascular system is certainly facilitated, so that they probably serve for respiratory purposes. These round clear spots are particularly numerous upon the contractile space of *Spirostomum ambiguum*. As, therefore, we do not possess the certain proof of one of the most essential requirements of a water-vascular system, the existence of an external orifice, and some things even appear to be directly opposed to it, we can only, like Wiegmann†, Von Siebold, and others, regard it as a blood-vascular system.

Before passing to the consideration of the nucleus, we will refer to some other conditions of structure, although these have only been detected in particular Infusoria, as the consideration of the nucleus cannot be separated from that of the reproduction, which then still remains to be examined.

Of other systems of organs, besides the nutritive and circulatory apparatus already referred to, we have comparatively little to say, and that mostly of a negative nature. If the clear spots already mentioned on the contractile vesicle are not to be regarded as the indications of a respiratory system, nothing is known of such a system, as Pouchet's supposed respiratory apparatus of the *Vorticellæ* is only their pharynx. The above-mentioned thinner spots in the skin may facilitate respiration, which probably otherwise takes place by the whole skin.

Nothing is known of organs of secretion, although Ehrenberg describes such organs in *Nassula elegans*, *Chilodon ornatus*, and other species, as the sources of a coloured gastric juice; but the coloured spots which they are said to form are regarded by others (Von Siebold) only as pigment-spots. In most, if not all Infusoria the whole surface of the body is capable of exuding a gelatinous matter. Some do this regularly, and the gelatinous matter exuded either retains its gelatinous consistence (*Stentor*, *Chaetospira mucicola*, and others), or, hardening into a horny matter (*Arcellina*, *Ophrydina*, *Tintinnus*, *Chaetospira Mülleri*, &c.), forms a sheath (*urceolus*) into which the animal can retract itself more or less completely. In some species of the genus *Diffugia* grains of sand are stuck into this hardening sheath; in the *Polythalamia* it becomes calcified. Besides this exudation of

* Froriep's Notizen, 1849, p. 6, and Vergl. Anat. p. 220.

† Archiv, 1835, i. p. 12.

gelatinous matter for the purpose of forming sheaths, another gelatinous exudation also occurs in a great many Infusoria, which leads to the formation of a completely closed and generally round case enclosing the animal which secretes it: this is the cyst-formation, first described by Guanzati, and so often observed of late, the object of which appears to be the protection of the encysted animal from unfavourable circumstances in the water inhabited by it, and from death by desiccation. How far encystation is connected with reproduction, we shall see hereafter. The cysts are not always smooth; thus Cienkowski* saw *Podophrya fixa* form transversely annulated cysts† and also describes other cysts with a stellate surface (*Stylonychia pustulata*‡); Stein observed longitudinally-ribbed cysts in *Epistylis branchiophila*; and I have seen finely-shagreened ones in a small undescribed species of *Epistylis*.

A nervous system has not yet been detected. Whether the pigment-spots regarded by Ehrenberg in some Infusoria as eyespots, are really so, is uncertain; a peculiar refractive body has not yet been detected in them, whilst one occurs in the form of a concavo-convex lens without a pigment-spot, close to the mouth, in *Bursaria flava*, Ehrbg. Whether the clear bodies which Ehrenberg supposed were to be regarded as ganglia in some flagellated Infusoria, and the reniform bodies discovered by Stein in the peristome of *Opercularia articulata*§ belong to a nervous system, is still very problematical.

With the exception of the cilia and other external appendages of the body already mentioned, special organs of motion have hardly yet been detected. Ehrenberg's account of muscular striæ giving origin to the series of cilia in many Infusoria is not satisfactorily confirmed, and is regarded by most authors as founded upon an illusion. The parenchyma of the body (not the skin) of most Infusoria is contractile, although no one has yet succeeded in distinguishing special muscles or muscular layers. I have also been unsuccessful in my search for them; but, on the other hand, I was so fortunate, in common with my friend, E. Claparède, as to observe an indubitable separate contractile layer, in which longitudinal striæ were generally to be

* Siebold and Kölliker's Zeitschr. vi. p. 302, and Bull. de l'Acad. Impériale de St. Pétersb. 1855, p. 297.

† Stein regarded these cysts as transition steps between *Vorticella microstoma* and *Podophrya fixa*, and thought that they were produced by the encystation of the former, and not of the latter. Weisse described them (Bull. Acad. St. Pétersb.) as independent Infusoria, under the name of *Orcula trochus*.

‡ I have also seen these cysts, and think that they are what Weisse has described (Bulletin, &c.) under the name of *Discodella multipes*.

§ Loc. cit. p. 117.

detected, in various *Vorticellinae*, in which Ehrenberg states that he saw muscular striæ at the posterior extremity. It forms a hollow cone, the apex of which is situated in the hinder extremity of the animal, and, in the contractile-stemmed species, is produced into the muscle of the stem; in its apparent section it of course appears like two small fibres separating from each other like a fork, as which, indeed, it has hitherto been always regarded, except by Ehrenberg*. This layer is very beautifully seen in *Epistylis plicatilis*, in which we may most completely convince ourselves that it is a special stratum, which possesses contractility. In *Epistylis plicatilis*, namely, during the contraction of this stratum, the non-contractile part of the parenchyma which surrounds it, with the skin covering it, separates from the contractile layer, and forms the well-known folds, whilst the contractile or muscular layer becomes shortened and thickened without folding. The structure of the contractile stem is carefully treated of by Stein† and especially by Czermak‡, to whose statements I may refer. As the sole function of the innermost part of this stem appears to be contraction, and it is not perfectly structureless, I think we need not hesitate in calling it a stem-muscle; and I cannot allow any value to Stein's objection, namely, that it still contracts even when the stem is not attached to another object, for the muscle does not thus lose its insertion, as it is attached to the sheath of the stem itself by its hinder extremity, and not to the foreign object. Perhaps the transverse annulations which are exhibited by the bodies of some *Vorticellinae*, are to be attributed to muscular fibres; at all events, they do not belong to the skin, but to the parenchyma of the body.

After we have thus mentioned what has been ascertained up to this time with regard to organs unconnected with reproduction in the Infusoria, nothing remains to be considered except the mode of propagation.

Without entering into a controversy upon the *generatio æquivoca*, which now, fortunately for science, is almost solely defended by men§ whose observations are so superficial, that no criticism of them is necessary, we may pass at once to the true

* Stein asserts that this does not occur in all contractile-stemmed *Vorticellinae*; I have always succeeded in seeing it, even in the *Vorticella microstoma* and *Zoothamnium affine*, St., which Stein represents without it.

† *Loc. cit.* p. 78.

‡ Siebold and K lliker's Zeitschr. iv. p. 438. I cannot confirm Czermak's statement, that the stem of the *Vorticellinae* is sometimes twisted to the right and sometimes to the left, as I have always found it twisted in the same direction as the spiral of cilia, in a great number of cases in which I examined it carefully with this view.

§ Pineau, Dr. Gros, &c.

modes of reproduction of the Infusoria. In them we meet with an undoubtedly asexual reproduction, and also with a mode of propagation which it is probable will hereafter be proved to be of a sexual nature, or which must be regarded as the analogue of the sexual reproduction of the higher animals,—namely, a propagation by embryos. The purely vegetative mode of propagation consists in fission and gemmation.

Fission, as is well known, is the most widely-diffused mode of propagation of the Infusoria, and the one with which we have been longest acquainted. Nevertheless, it has not been so closely studied as, perhaps, it deserved; for our knowledge of it has made but little progress since Trembley's beautiful description of the fission of the *Stentors*. By the generalization of a few observations, principally with reference to the cell-theory, we have come very recently to believe that the nucleus always induces the fission by its becoming divided, or at least constricted. This view, however, is not correct. There are certainly cases in which the nucleus first of all divides, but in other cases its division only takes place when the rest of the body is already far advanced in division; and in others again the actual fission of the nucleus does not lead to that of the body, but embryos are developed in it, as we shall soon show. The fission is generally commenced rather by a new formation of contractile vesicles*, from dilatations of the existing vessels, as appears from Stein's observations on *Stentor*. In those Infusoria in which a peculiar series of stronger cilia leads to the mouth (such as *Oxytrichinae* and *Euplotea*), the furrow in which this series of cilia is situated, is seen subsequently [to,] or simultaneously [with the division of the contractile vesicle] to become produced backwards over the mouth; in this prolongation cilia are produced, and its posterior extremity becomes deepened into a mouth and oesophagus, which then opens towards the alimentary cavity of the animal; then, simultaneously with the external constriction of the body, the new furrow is separated from the old one. (In *Stentor* the new frontal series of cilia first makes its appearance on the old animal as a lateral, straight series,—the *crista lateralis* of Ehrenberg.) In animals which also possess peculiar processes of the body as organs of motion (hooks, styles, &c.), the fission usually takes place in such a manner, that each of the newly-formed animals acquires a portion of these from the old animal, whilst the other part is of new form-

* Even Ehrenberg refers to this in some cases. Wiegmann adduces it in support of his opinion that the contractile vesicle is to be regarded as the heart. The greater part of the following observations on the development of the Infusoria were made by me in conjunction with my friend, E. Claparède.

ation. Stein gives an incorrect representation of the fission of the *Vorticellinae*, as he supposes that before this takes place the ciliary disk, œsophagus, &c. of the old animal are absorbed, and when the fission has advanced further, two new ciliary disks are formed. This, however, is not the case: by careful observation the movement of the cilia is seen, during the whole process of fission, upon the ciliary apparatus, and in the vestibulum and œsophagus of the animal which is closed up by the peristome.

Fission had not been previously observed in the family of the *Acinetinae*, and it has only been very recently described by Cienkowski* in *Podophrya fixa*; one of the two buds of fission acquires cilia all over it, retracts its suckers, and swims away, becoming again converted into a *Podophrya* by the loss of its cilia; the same thing takes place in *Acineta mystacina*, and here also one of the buds of fission is ciliated all over.

Far less general than fission is the process of gemmation, which is only known as yet in *Vorticellinae*, *Acinetinae* (here only in *Dendrosoma radians*, Ehrbg.), and in *Spirochona gemmipara*, Stein, the position of which still appears doubtful to me†. In the *Vorticellinae* the bud is formed as a swelling of the parenchyma on some part of the body, into which a diverticulum of the digestive cavity of the parent animal extends. The alimentary cavity of the bud thus formed is subsequently divided from that of the mother, and finally the entire bud separates, with development of a posterior circle of cilia. In *Dendrosoma radians*, Ehrbg., a branch of the nucleus grows into the bud whilst it still remains united to the parent animal. Fission and gemmation pass into each other almost imperceptibly, as the buds of gemmation are not always much smaller than their parent; if it be desired to draw a sharp line of demarcation between them, we may say that in fission each of the new-formed animals acquires a pre-existing part of the nucleus of the old animal; whilst in gemmation, one part, the bud, only acquires a newly-formed part of the old nucleus, or none at all; (in the latter case, of course, a nucleus must be developed independently in the bud).

The true generation has only been known at a very recent period. The first observation upon this subject, which, however,

* Bull. Acad. de St. Pétersb., 1855, p. 297.

† In Müller's Archiv for 1854, p. 205, A. Schneider describes a mode of propagation in *Diffugia Enochelys* as sprouting or gemmation, which, nevertheless, is perhaps more properly to be regarded as fission. Stein also describes (p. 191) a propagation by formation of buds in *Uvella bodo*, Ehrbg. = *Phacelomonas bodo*, Stein.

has been completely disregarded, was made by Von Siebold*, upon an Infusorium (*Bursaria* or *Opalina*) living as a parasite in the intestine of the Frog: in this he found a number of small embryos in a cavity at the posterior extremity of the body. Embryos were subsequently rediscovered, first by Focke† (whose observations were confirmed and enlarged by Cohn‡ and Stein§) in *Paramecium Bursaria*, Focke = *Loxodes Bursaria*, Ehrbg., then by Eckhardt|| in *Stentor polymorphus* and *caruleus* (confirmed by O. Schmidt¶), by Stein** in many *Acinetæ* and in *Chilodon*, and, although less exactly, by Cohn†† in *Urostyla grandis*. From the observations of Focke and Stein, a division of the nucleus appeared to take place in the formation of embryos; whilst Eckhardt does not refer to this, and Cohn regards its division as improbable. I have been so fortunate as to observe the formation of embryos, not only in many *Acinetinæ*, but also in numerous other Infusoria. As the description of these observations, which were for the most part made in conjunction with E. Claparède, would lead us too far, we shall furnish this in a separate memoir; and I only give here the scheme of development, such as we have observed it more or less completely in different cases.

The development of the embryos takes place in the nucleus, or in a part of it. The nucleus is usually seen first of all to divide into two or more parts, when the same processes take place in one or several of these parts, which in other cases occur in the undivided nucleus. The nucleus is usually roundish or longish, or even (as in many *Vorticellinæ* and *Stentor*) much elongated and band-like: it is enveloped in a peculiar membrane, as Stein has proved, and generally presents a homogeneous or finely granular appearance; it appears constantly to enclose a cavity surrounded by thick walls (the substance of the nucleus), sometimes (*Chilodon*) containing a smaller body, the nucleolus, which in other species is situated close to the nucleus. Upon or in the wall of the nucleus or one of its products of division, we now sometimes perceive small round globules, which increase in size, finally acquire a contractile vesicle, and become converted into embryos; these at last become furnished with cilia, escape out of the parent animal, and swim about

* In his Memoir upon the development of *Monostomum mutabile*, in Wiegmann's Archiv, 1835.

† Amtlicher Bericht der Naturforscherversammlung zu Bremen, 1844, p. 110.

‡ Siebold and Kölliker's Zeitschr. iii. p. 277.

§ *Op. cit. supra.*

|| Wiegmann's Archiv, 1846.

¶ Froriep's Notizen, 1849, p. 7.

** *L. c. supra.*

†† *L. c. supra.*

freely, generally in a form more or less differing from that of the mother. Very different numbers of embryos may be formed in one section of the nucleus; in the same species we sometimes find many and sometimes only one embryo formed in it; and an embryo which has been developed alone in a fragment of the nucleus is usually as large as all the embryos formed in a similar fragment which has developed many of them, taken together.

The true import of the nucleus of course is not decided by this statement; [we cannot say] whether it is to be regarded as a germ-stock, in which germs are formed asexually; as an ovary, in which the ova are developed at the same time; or, in accordance with Focke's views, as a uterus, in which the ova or germs, formed in another place (perhaps in the nucleolus?), are further developed.

The fate of the embryos which are unlike their parents, after their birth, is still unknown in most cases. For the *Acinetæ*, Stein, as is well known, has set up a peculiar theory, which he has endeavoured to support by many examples; according to this, the *Acinetæ* are metamorphosed *Vorticellæ*, which, in this altered form, assist in propagation by the production of embryos; the embryos, as Stein supposed, again became *Vorticellæ*: unfortunately he never observed this directly, but always lost sight of the embryos before their fate was decided. In support of the transformation of the *Vorticellæ* into *Acinetæ*, he brought forward some supposed transitions, the series of which, however, still presented considerable gaps. Many of these intermediate forms, which are always encysted states, have so far distinct characters, that they might also be referred as encysted states to a great many other Infusoria, so that they can only furnish a proof of the asserted transition, when we are certain that, in a series of observations upon the transformation of one species, we have always to do with the same individual, so as to exclude the possibility of confounding individuals of other species therewith. For, the reason, and almost the only one, that Stein can adduce in favour of his opinion, in most of the *Acinetæ*, except the analogy with the other *Acinetæ*, which led him to think their relationship to the *Vorticellæ* probable,—namely, the frequent occurrence of certain *Acinetæ* and *Vorticellæ* in each other's company,—is evidently no more a proof of relationship in this than in other cases. The frequent parasitism of certain *Acinetæ* upon certain *Vorticellinæ* furnishes no better proof; we often find other Infusorial parasites upon the same *Vorticellinæ*, so that we have our choice as to which we will regard as related to the host.

In favour of the relationship between some *Acinetina* and *Vorticellinæ*, Stein adduces an alternation in their occurrence; so

that in a vessel which at first contained a great number of *Vorticella microstoma*, these in course of time gradually diminished, whilst individuals of a particular species of *Acineta*, in this case *Podophrya fixa*, made their appearance in constantly increasing numbers. In this case changes may very probably have taken place in the conditions of the surrounding medium, which were unfavourable to the former species, and compelled them to become encysted, whilst they probably only furnished the other species with the favourable conditions for their existence and propagation. A similar alternation in the occurrence of species is observed in many species*, so that the admission of their relationship would compel us, with Pineau†, Dr. G. Gros‡, and Laurent§, to regard the greater part of the Infusoria as stages in the development of the same species, nay, even to place them in relationship to the Rotifera, Worms, and Crustacea. In the alleged relation between *Vorticella microstoma* and an *Acineta*, we also find a very natural reason for the simultaneous increase of the *Acineta* and diminution of the *Vorticella*, in the fact that the latter are very often sucked out by the former, frequently three to four *Vorticellæ* at once by a single *Acineta*. The supposed intermediate steps between the two forms of Infusoria are, as Cienkowsky|| has proved by direct observation, in part erroneously explained. Stein's transversely costate cyst (tab. 4. fig. 80¶), which he supposes to have been produced from a *Vorticella*-cyst, and to pass into a *Podophrya*, through the state represented in fig. 31, according to Cienkowsky was rather produced through the intermediate step, fig. 31, from a *Podophrya*, but without becoming converted into a *Vorticella*-cyst.

An alternation of this kind in the appearances of particular Infusoria, can only allow us to conclude that they are related, when we have convinced ourselves by strict isolation that there are only individuals of the one species and none of the other in a particular small space, when we take care that none of these can have access from without, and enable ourselves to watch the individuals. This has always been neglected by Stein; only one of his observations** appears nearly to fulfil this requirement, so

* See Schrank, Fauna Boica, iii. 2. p. 19; Cohn, in Siebold and Kölliker's Zeitschr. iii. p. 258, &c.

† Ann. des Sci. Nat. 3 série, iii. p. 182, iv. p. 103, and ix. p. 100.

‡ Ann. des Sci. Nat. 3 série, xvii. p. 193, and various papers in the Bull. de la Soc. Imp. de Naturalistes de Moscou.

§ Various memoirs in the Mémoires de la Soc. des Sciences, &c. de Nancy, and Etudes Physiol. sur les Animalcules des Infusions Végétales, 1854.

|| Bull. de l'Acad. de St. Pétersb. 1855, p. 297.

¶ *Orcula Trechus* of Weisse.

** L. c. supra, p. 39.

that it seems to have led him to the incorrect assertion*, that he had "by direct observation" seen *Vaginicola crystallina* become converted into *Acineta mystacina*. But even this observation was not exact. On a number of filaments of *Confervæ* which he had thrown into a glass filled with clear spring-water, because they were particularly rich in *Vaginicolæ*, Stein found, after the lapse of several days, "instead of the *Vaginicolæ* scarcely anything but *Acinetæ*." Stein does not say that he convinced himself that at the commencement there were no *Acinetæ* at all adhering to the *Confervæ*, or that he obtained any certainty as to the identity of the individuals by the identity of the spot on which an *Acineta* sat with that to which a *Vaginicola* was previously attached,—two things which certainly ought to have been done in order to prove a direct observation of the transition of one form into the other; and yet, as he could not find the sheaths of the *Vaginicolæ*, which had probably fallen down, he allows himself to be led away into a bold hypothesis, which is to solve the difficult problem of the conversion of the hard sheath of the *Vaginicolæ*, which is widest at the bottom, into an *Acineta*-sheath, which is narrow at the base.

I now endeavoured to settle the existing doubts by strict isolation. For three years I have effected this, at different times, with different *Vorticellinæ*, namely with *Vorticella microstoma*, *campanula*, and *nebulifera*; *Carchesium polypinum*; *Epistylis plicatilis*, and *Opercularia nutans*: on each occasion I preserved about twenty or thirty individuals of one of the above-mentioned species, sometimes in a small glass tube, sometimes on an object-glass, keeping them moist, and preventing desiccation by the occasional addition of distilled water. In this way I obtained cysts of *Vorticella microstoma* often enough, but no *Acinetinæ* were ever developed either from this or from the other *Vorticellinæ*. From the cysts of *Vorticella microstoma* unaltered *Vorticellæ* escaped, sometimes at the end of three or even four weeks.

After I had convinced myself that the conversion of *Vorticellæ* into *Acinetæ* was not to be proved in this way, but was rather rendered more improbable by the experiments instituted, I attempted to test the other part of Stein's hypothesis,—to ascertain the fate of the embryo of *Acineta*. An observation of Professor J. Müller, which renders probable the conversion of such young animals into an *Acineta* resembling the parent, has already been adduced. Subsequently I succeeded several times in obtaining a certain result. In order to facilitate observation and avoid confounding the roving embryos with similar animals, I generally isolated each *Acineta*, containing one or two em-

* *L. c. supra*, p. 36.

bryos, in a drop of water upon an object-glass, and then observed the escape, the roving, and lastly the quiescence of the bud. Thus I could even quit the microscope for some time, and yet be sure of again finding the same individual, and not confounding it with others; in some cases I remained the whole time at the microscope. I first succeeded in the summer of 1853, when in Würzburg, in tracing the fate of some buds of *Acineta*, which I at first regarded as Stein's *Acineta* of the Duckweed, but which I do not now consider to be distinct from Stein's *Acineta* of the *Cyclops*, although it attached itself to the Duckweed or swam about freely in the water*. Cienkowski† also has recently followed the destiny of the embryo of an *Acineta*, which appears probably to be identical with that above mentioned, for, that Cienkowski (as well as Stein for his *Acineta* of the *Cyclops*) figures the embryo much smaller than I have ever seen it, can certainly not constitute a specific distinction, as in other Infusoria also, the buds of one species, nay even of one individual, may be of very different size. Cienkowski arrived at the same result as myself: after roving about very rapidly for a time, the bud became quiescent, lost its cilia, and developed the radiate suckers which characterized it as an *Acineta*. The period of the rapid swarming of the embryos of *Acineta* is very variable: I have observed some which attached themselves to become converted into *Acineta* within half an hour, whilst in other cases I had to wait for several hours. Cienkowski states that he has followed the embryo for more than five hours before it became quiescent. Embryos of the *Acineta ferrum-equinum*, Ehrbg., I certainly did not follow during the whole period of their swarming under the microscope; but, by careful isolation, I had ensured the identity of the individual without uninterrupted observation. I then always found, after the lapse of several hours, besides the old *Acineta*, a young one of the size of the gemmule. I once followed one of these, until, after some hours of roving, it reposed upon a fragment of *Lemna*; a few hours afterwards I found in the same spot a young *Acineta* of exactly the size of the bud. Similar observations were afterwards made by E. Claparède and myself upon some other *Acineta*, and always with the same result, although sometimes the bud died before becoming converted into an *Acineta*.

If proof was thus furnished that the embryos of *Acineta* were again converted into *Acineta*, the objection might still be raised that this was perhaps to be laid to the unfavourable circumstances to which the animals were exposed in the little drop of water under the microscope, and that, under more favourable

* Stein's *Acineta* of the Duckweed may probably be a peculiar species.

† Bull. de l'Acad. de St. Pétersb. 1855, p. 297.

conditions, the embryos were probably converted into *Vorticellæ*. I therefore endeavoured to ascertain this also, and for this purpose isolated at different times a number of individuals of the large *Acineta ferrum-equinum*, Ehrbg., which were perceptible even with the lens, in a small glass tube, as I had isolated *Vorticellæ* in other cases. In order that they should not be in want of nourishment, I put a number of individuals of *Paramecium Aurelia* and *P. Bursaria* with them in the tube, and to preserve the water in a good state, also placed in it a *Lemna minor*. These experiments required the greatest care, and their difficulty is a sufficient explanation of my not having obtained clear results in all cases. Thus in one case I found two specimens of *Vorticella campanula* in one of my glasses, when I came to look at it again in eight days; in another I found several of the *Vorticella nebulifera* without a single *V. campanula*. This difference of the *Vorticellæ* discovered must show at once that they had only got in by accident, and had not been developed from the embryos of the *Acineta*. How difficult it is to avoid such an accident, was proved to me by a case in which I had placed some *Acineta* in a glass tube, and thought that I had convinced myself of the absence of any *Vorticellina*; and yet, on again examining it with the lens, I discovered, under the leaf of *Lemna* which had been put in, a large *Vorticella campanula*, which I of course took care to remove immediately. Two experiments, however, gave me a perfectly clear result. One of these was given up at the end of a week, but the other was continued for seven weeks, during which the contents of the glass tube were frequently examined, partly with the lens and partly with the microscope; but in both I never obtained a single *Vorticella*, but only a considerably increased number of *Acineta*. The number of the latter was also augmented in the other experiments, which did not give a pure result.

The preceding statements appear to me to furnish sufficient proof that Stein's opinion of the relationship of the *Vorticellina* and *Acineta* is not only completely destitute of any real foundation, but even, as an hypothesis, extremely improbable. I must be excused if I have dwelt too long upon this theory; but it appeared to be well worth a thorough examination, as it introduced into science a perfectly new mode of propagation, which could not be referred to any of the known modes of reproduction, not even to the alternation of generations; and it was certainly high time to apply the standard of a fundamental criticism to it, as it has unfortunately been already regarded by many as a fact ascertained with certainty. An alternation of generations of the kind hitherto known in other animals cannot be recognized in the alternation of the modes of reproduction of the Infusoria,

the increase by fission or gemmation, and that by embryos*; for the same animal which has propagated vegetatively for a time by fission and bud-formation, and consequently performed the functions of a nurse, may be seen subsequently playing the part of a mother by the production of embryos; nay, one animal may at the same time increase by the vegetative process of fission and propagate by the development of embryos, as is proved to me by observations on Stentors. If an alternation of generations in the received sense should occur amongst the Infusoria, it could only be in this way, that the very small embryos produced in the nucleus, or those to be mentioned immediately, might be produced asexually, and even when sexually mature might not increase vegetatively, but by sexual reproduction; but this supposition is totally unsupported, and even contradicted by the observations on the *Acineta*.

I may now be permitted to mention a mode of reproduction which has hitherto been observed in but few cases, and even in these not sufficiently to enable us to decide whether it is to be regarded as a modification of the above-mentioned production of embryos in the nucleus, or as an independent kind of propagation. It has as yet been described only by Stein† in *Vorticella microstoma* and *nebulifera*, and by Cienkowsky‡ in *Nassula viridis*§.

In these cases the reproduction was commenced by encystation, and then several large circumscribed bodies, probably enlarged parts of the nucleus, made their appearance in the body, which gradually became converted into a simple vesicle without recognizable organs (the mother-vesicle, *Mutterblase* of Stein): these afterwards became elongated into processes, which broke through the cyst, and bursting at the apex, allowed a great number of small, Monad-like creatures to escape, which soon dispersed themselves in the water. It was only in his most recent observations on *Vorticella microstoma*, that Stein saw the production of larger globules, "daughter-vesicles" (*Tochterblasen*), in the interior of the mother-vesicle; but previously he had seen nothing of the kind: it must remain uncertain whether

* Even if this were proved to be sexual reproduction.

† *L. c. supra*.

‡ Siebold and Kölliker's Zeitschr. vi. p. 301. In a note (4) on p. 301 of the Bulletin de l'Acad. de St. Pétersb., Cienkowsky mentions the same circumstance with regard to *Nassula ambigua*, Stein. I do not know whether by this he refers to the same observations with regard to *Nassula viridis*, alluded to above.

§ Perhaps the reproduction of *Chlorogonium euehlorum*, described by Weisse and Stein, also belongs here (unless it be a division into numerous segments after a change of skin), and possibly the state of *Acineta mystacina* represented by Stein on tab. 1. fig. 20 of his work.

he had overlooked them; whether, instead of several globules, only one very large one, entirely filling the mother-vesicle, had been produced; or whether two different modes of development actually occur in this case. This is the only mode of reproduction of the Infusoria which has hitherto been observed in encysted animals alone; but some observations made by E. Claparède and myself upon an undescribed vaginicolous Infusorium, indicate that encystation is not a necessary condition even for this mode of propagation. The internal formation of embryos in *Chilodon* has been observed by Stein, especially in encysted animals, but nevertheless, according to him, it also occurs in free animals. Fission is very frequent in the interior of cysts; many Infusoria appear to undergo fission more frequently in cysts than when swimming freely; so that it may appear probable that the cyst serves as a protection for the animal when dividing, but it is certainly not necessary, as we are acquainted with no example of an Infusorium which always encysts itself for the purpose of fission. Thus the principal, if not the only object of encystation appears to be protection against unfavourable external circumstances.

With regard to the peculiar process of copulation or zygosis of the Infusoria, as its object is still entirely unknown, I shall only state, that, except in the Diatomaceæ and Desmidiaceæ, the position of which is still doubtful, it has hitherto been observed particularly in *Actinophrys* and *Acinetina**. According to an oral statement, E. Claparède has also seen *Vorticellina* (especially *V. microstoma*) in zygosis; and I have twice met with double animals of *Carchesium*, still sitting upon a double stalk and constantly becoming more amalgamated, so that the cavities of both the fused animals communicated, and the morsel which was passed from the pharynx of one animal usually ascended in the cavity of the other up to the lower surface of its ciliary disk. The rotatory organs remained separate, and after the lapse of some time, the double animal cast itself loose from the stems, and swam about for more than twenty-four hours by means of a circlet of cilia, which was produced around the rounded hinder extremity formed by the coalescence of the two posterior extremities of the individual animals.

If we now once more sum up the results of the preceding statements, we find,—that the Infusoria cannot be regarded as unicellular animals, although they have not a polygastric digestive apparatus, but possess a large alimentary cavity furnished with an anus, and into which an œsophagus usually hangs down from the mouth; that a vascular system, of which the central

* I have seen several in conjugation; amongst others, even the *Acinetomyx*.

point is formed by the contractile vesicle, is contained in the parenchyma of the body of all; that, besides fission and gemmation, they possess another mode of reproduction, in which small embryos are formed in the nucleus, but that an alternation of generations has never been detected in the Infusoria; and, lastly, that Stein's view of the connexion of the *Vorticella* and *Acineta* is an unfounded and improbable hypothesis.

EXPLANATION OF PLATE IX.

All the figures, with the exception of fig. 8, are magnified about 300 diameters. The lettering of the separate parts is, as far as possible, the same in all the figures; so that *a, a* indicates the peristome; *b*, the commencement of the series of cilia leading to the mouth; *c, d*, in the *Vorticella*, the entrance into the vestibulum, which lies between *c, d* and *e, f*; *e*, the anus; *f*, the mouth; *g*, the outer extremity of the bristle situated in the vestibulum; *h*, or *f, h*, the oesophagus; *k, i*, the pharynx; and *k*, the contractile vesicle.

Figs. 1-5. Vorticellinae. Of the cilia of the outer series, only those which are visible at the margin of the figure are indicated.

Fig. 1. Vorticella campanula, seen from the ventral side. At *e* we see through the mouth into the lumen of the oesophagus; the pharynx is not visible in this position; of the stronger cilia situated in front of the mouth, only one is represented. The pale curved body represents the nucleus.

Fig. 2. Vorticella nebulifera, inflated and dying, so that the peristome is obliterated. The portion of the ciliary spiral which is situated on the back of the animal is only indicated by a dotted line.

Fig. 3. Carchesium polypinum, seen from the front directly upon the ciliary disk; the ciliary spiral is only indicated by a dotted line. The pharynx is only seen in section: *k* represents the section of the process running from the contractile vesicle towards the ciliary disk.

Fig. 4. Opercularia berberina, Stein, seen from the back. The portion of the ciliary spiral situated in the vestibulum is only indicated by a line. At *l*, in this and the following figure, a still fusiform morsel is represented. The pale body to the left above *h* represents a section of the nucleus.

Fig. 5. Scyphidia limacina, Lachm. By mistake, the cilia are not represented on the extreme margin of the ciliary disk, as they should be.

Figs. 6, 7. Chaetospira Mülleri, Lachm., sitting in its sheath, *n*. Of the fine cilia covering the whole body, a few are represented only in fig. 6.

Fig. 6. A rotating animal. At *m* is a ball of excrement on its way to the anus.

Fig. 7. An animal only just extended, and not rotating.

Fig. 8. Stentor polymorphus, not much magnified. On the right side the contractile vesicle, *k*, is seen, with the lateral vessel, exhibiting various inflations, running backward; *o, o* are the two dilatations of the annular vessel. The anus, *e*, lies on the dorsal surface, which is turned from the observer.

Fig. 9 shows a section through the posterior extremity of a *Stentor*. The thin, pale, outermost portion represents the skin bearing the cilia and hairs; and the darker portion, situated more internally, the

parenchyma of the body, in which some dilatations of the longitudinal vessel are placed. The arrows in the alimentary cavity indicate the direction of the chyme-current, as in all other figures where they are introduced.

Fig. 10. *Euplates Charon*, seen from the ventral surface.

Fig. 11. Diagrammatic section of a *Paramecium*. Externally is the skin bearing the cilia; then the parenchyma of the body, containing the two contractile vesicles and enclosing the digestive cavity. Behind the mouth is the anus.

Fig. 12. *Amphileptus fuscicola*.

Fig. 13. *Euchelys sarcimen*, containing a small Infusorium which it has devoured; the animal itself is being sucked out by

Fig. 14. A small *Acineta ferrum-equinum*, Ehrbg. This is pale in consequence of long fasting, so that the horseshoe-shaped nucleus is recognized. After feeding, it acquires the dark appearance of fig. 15.

XX. Descriptions of new Ceylon Coleoptera.

By JOHN NIETNER, Colombo, Ceylon*.

Family CARABIDÆ.

Tribe CHLÆNIDÆ.

1. *Chlænus Ceylanicus*, N.

C. subellipticus, subconvexus, glaberrimus, nitidus; supra brunneo-xeneus, capite, thoracis elytrorumque marginibus aureo-viridibus; subtus piceus, margine, pedibus oreque dilute castaneis. Long. corp. 5½ lin.

Caput ante oculos 2-impressum. Antennæ art. 3^o quarto paulo longiore. Mentum dente magno excavato. Thorax subquadratus, latitudine parum longior, obsolete punctulatus, antice subconvexus, lateribus deflexus, postice depressus, planus, 2-impressus. Elytra subtiliter striato-punctata, obsoletissime punctulata.

In stagnorum ripis inter arundines habitat; in prov. occid. et merid. infrequenter legi. Per occasionem nocte ad lumen advolat.

A handsome and interesting species, distinguished as well by its general shape, which is more elliptic and convex than usual, as by its polished surface. The head is oblong and, with the exception of the mouth, the parts of which are of a deep brown, of a bright metallic green, divided longitudinally by a streak of copper colour. The thorax is rather longer than broad, round in front and flat behind, and finely punctured all over; it is of a brownish metallic colour bordered laterally with bright green. The elytra are of the same colour as the thorax, the same bright green stripe running along the sides; the margin, properly speaking, is deep brown; the elytra are impressed with rows of fine indistinct punctures, and with the usual series of larger setigerous

* From the Journal of the Asiatic Society of Bengal, No. V. 1856.
Ann. & Mag. N. Hist. Ser. 2. Vol. xix.

ones within the margin; they are rather narrowed near the apex.

The female, in addition to having the anterior tarsi not dilated, has the basal impression of the thorax of a somewhat semicircular shape, and is broader in the body than the male.

2. *Chlænium 5-maculatus*, N.

C. præcedente major, minus convexus, latior, rugosus, pubescens, supra obscure nigro-viridis; capite viridi-æneo, nitente, glahro, elytris maculis 5 flavis; subtus piceus, pedibus, elytrorum margine antennisque flavis, ore thoracisque margine magis minusve bruneis. Long. corp. 6½ lin.

Caput ante oculos leviter 2-impressum, punctulatum. Antennæ art. 3^o quarto plus sesqui longiore. Thorax subquadrato-rotundatus, latitudine haud brevior, dorso planus, ad basin 2-impressus, rugosus, pilosus. Elytra subdepressa, subtiliter striata, rugosa, pilosa, maculis 2 humeralibus, 2 intermediis, 1 apicali flavis ornata.

Specimen singulum m. in lacus Colombensis ripis sub graminibus putrescentibus legi.

Not less distinguished than the former, especially by the rounded shape of the thorax and the five yellowish spots with which the elytra are adorned. These are arranged in the following manner: two small ones at the shoulders; two large transverse ones at the middle, stretching from the external margin towards the suture, reaching, however, but little more than half-way across; one at the apex: this is of the shape of a hammer, and half in one and half in the other elytron. The palpi appear to me longer and more markedly elbowed at the joints than is usual with insects of this genus; the last joint is deeply excavated at the tip. The thorax is of suborbicular form, the back and hind part are flat, the sides slightly depressed, the margin sharp, the basal impressions very near the angles; it is, as are also the elytra, rough and finely pubescent, the striae of the latter being thereby rendered obsolete. Legs of male stout, anterior tarsi strongly dilated.

3. *Chlænium pulcher*, N.

C. elongatus, subconvexus, subglabratus, æneo-viridis, elytris obscurioribus, limbo pedibusque flavis, subtus piceus. Long. corp. 6½ lin.

Caput oblongum, nitidissimum, ante oculos 2-impressum. Mentum dente fortiter excavato. Antennæ art. 3^o quarto sesqui longiore. Thorax oblongus, basin versus angustatus, parce punctulatus, antice lateribus deflexus, postice dorsoque planus, basi 2-impressus. Elytra striata, ad striae, præcipue apicem versus, subtilissime pilosa, flavo-marginata. Pedes flavi, spiuulis castaneis. Abdomen flavo-marginatum.

Specimen singulum m. in ripis Maha-Oyæ fluminis prope Negombo cepi.

Distinguished by its elongate shape. The head is of a bright green colour, with the labrum and the mandibles of a deep, and the antennæ and palpi of a light brown, the latter being darkened towards the end. The thorax is of the same colour as the head, reflecting a copper hue from the back; its anterior angles are obtuse, the basal ones being right. The elytra are of the same greenish copper colour, but darker; they are impressed with longitudinal lines, which are bordered on each side by a row of minute hairs; they as well as the abdomen have a yellowish margin.

4. *Chlænius cupricollis*, N.

C. subconvexus, subglabratus, capite thoraceque cupreis, elytris nigro-teneis, limbo pedibusque flavis, subtus piceus. Long. corp. m. $5\frac{3}{4}$, f. $6\frac{1}{4}$ lin.

Præcedenti affinis. Caput ante oculos indistincte 2-impressum. Thorax ut in præcedente sed minor, antice lateribus magis deflexus, linea media impressionibusque basalibus longitudinalibus, præcipue in f. profundioribus. Pedes flavi, trochanteribus spinulisque castaneis. Elytra præcedentis.

In prov. occid. fluminum lacuumque ripis infrequenter legi.

Allied to the former, but easily distinguished by size, colour, and sculpture of the thorax. The male is shorter and the female plumper than the former. The thorax is smaller and, as is also the head, of a bright copper colour with greenish sides; its impressions, especially in the female, are deeper, and its anterior part laterally more deflexed. Moreover the yellowish margin of the abdomen is wanting, and the tooth of the mentum is not excavated. The elytra, antennæ and palpi, making allowances for size, &c., are the same as those of the former.

5. *Chlænius rugulosus*, N.

C. subconvexus, subglabratus, thorace occipiteque rugulosis cupreis, elytris nigro-viridibus, pedibus, elytrorum limbo lunulisque apicalibus flavis, subtus piceus, abdomine apice margineque flavis. Long. corp. $6\frac{1}{4}$ lin.

Caput fronte 2-impressum, subtilissimo longitudinaliter rugulosum. Menti dens laciniiis extus rotundatis. Thorax lateribus rotundatus, deflexus, basi sat fortiter angustatus, obsolete 2-impressus, parce punctatus, subtiliter transversim rugulosus. Elytra ut in præcedente sed apice utrinque lunula flava signata, ad strias distinctius pilosa, his apicem versus per paria coeuntibus. Pectus abdomenque picea, hujus segmentis 2 ultimis, præcedentis dimidio margineque flavis.

Specimen unicum f. in *Ch. pulchri*, N. societate cepi.

Of the general appearance of the two preceding species. The head finely longitudinally, the thorax transversely rugose; the latter with rounded and deflexed sides. The mandibles are of a deep brown; the palpi and antennæ of a yellowish colour, darkened towards the tip. The lobes of the mentum tooth are externally rounded. The elytra are marked by two subapical spots of yellowish colour and semilunar shape (the back of the lunules being turned towards the suture). The striæ verge near the apex by twos into each other. The abdomen is distinguished by having a yellow margin and apex.

Tribe SCARITIDÆ.

6. *Scarites minor*, N.

S. elongatus, *niger*, *nitidus*, *subtus nigro-piceus*, *pedibus piceis*, *tarsis*, *antennis*, *palpisque castaneis*. Long. corp. 5 lin., lat. 1½ lin.

Caput subquadratum, ante oculos 2-impressum, pone irregulariter sulcatulum. Mentum rugosum, medio costatum, lateribus utrinque profunde uni-sulcatum, lobis obtusis, dente forti, lobis paulo brevior. Maxillæ validæ, breves, apice extus leviter arcuatæ et excavatæ, subacuminatæ. Mandibulæ validæ, inter medium et basin fortiter dilatatæ, obtuse dentatæ, dextera dente obtuso subapicali, supra subtusque longitudinaliter sulcatæ. Antennæ art. 1^o sequentium trium, 2^o tertii prope longitudine. Thorax oblongo-quadratus, angulis anterioribus obtusis, posterioribus oblique truncatis, anguste marginatus. Elytra thoracis capitique prope longitudine, striata, ante medium ad striam 2^m uni-, apicem versus ad striam 3^m 2-punctata, punctis piliferis, basi granulata, angulis oblique truncatis, anguste marginata. Pedes anteriores tibiis apice extus 5-dentatis, dentibus 2 ultimis parvis, omnes tarsis subtus leviter excavatis.

In prov. occid. arenis humidis sub vegetabilibus putrescentibus specimina nonnulla legi.

Scarce. But little distinguished excepting by its size, for which reason a lengthened description becomes necessary. The head is subquadrate in front, with two deep longitudinal impressions behind the eyes, finely sulcated. The labrum is of the usual shape; the eyes are not very prominent. The antennæ are of about the same length as the head; the first joint is about as long as the three following together; the second, which is generally longer than the third, is in this case of the same length; joints 1-4 are naked, 5-11 pilose, increasing gradually towards the tip in size and thickness, taking at the same time a subquadrate and depressed shape. The mandibles are strong, much dilated, and dentated from before the middle to the base, the right one having an additional subapical tooth. The maxillæ also are strong, but slightly bent at the apex, where they are also slightly excavated. The labial palpi have the last joint longer

than the third, elongated and elliptic. The thorax is oblong, with the basal angles obliquely truncated. The elytra are oval, striated, granulated at the base, and have, as has also the thorax, a narrow margin. The anterior tibiæ are furnished externally with five teeth, the two last of which, however, are very small; the posterior legs are similarly provided, but the teeth are indistinct. The joints of the tarsi are slightly excavated below. The sides of the body below are rugose.

7. *Clivina rugosifrons*, N.

C. ferruginea, capite thorace abdomineque piceis. Long. corp. 4½ lin., lat. 1½ lin.

Caput rugosum, inter oculos elevatum, elevatione plana antice profunde l-impressa. Mentum lobis subtiliter sulcatis. Antennæ robustæ, thoracis medium vix attingentes, art. ultimo elongato, penultimo —, art. 2º tertio sesqui longiore. Thorax subquadratus, antice parum angustatus, elytrorum latitudine, subtus parce punctatus, prosterno sulcato. Elytra striata, in striis punctata. Pedum tibiis anterioribus apice extus 4-dentatis, subtus excavatis, tibiis reliquis fortiter spinosis; tarsorum articulis margine apicali setoso.

In prov. occid. sub vegetabilibus putrescentibus infrequentissime legi.

A large and distinguished species. The head is very rugose; the clypeus is contracted behind the apical angles and then produced again into another pair of angles. The labrum is transverse, slightly sinuate in front, with the angles rounded and setose. The mentum is quadrate, the lobes rounded at the apex and slightly sulcated; the tooth is strong, of equal length with the lobes, and of the typical spear-headed form. The ligula has the apical angle much elongated, terminating in a membranaceous bristle which is bifurcate at the tip. The maxillary palpi have the last joint elongate, cylindrico-conic; that of the labial ones is still more elongate, elliptic. The antennæ have the basal joints elongate, those towards the tip rounded; they and the legs are hairy, otherwise the insect is of a bright, polished surface.

8. *Clivina elongatula*, N.

C. elongata, subdepressa, supra nigro-picea, subtus picea, pedibus elytrorumque marginibus castaneis, antennis orque dilutioribus. Long. corp. vix 3 lin., lat. ½ lin.

Caput triangulare, subtiliter punctato-rugosum. Palpi articulo ultimo apice leviter truncato. Thorax oblonge quadratus, ante apicem leviter sinuosus, parce obsoleteque transversim strigosus. Elytra striata, in striis punctata, ad striam 3^m utrinque 4-punctata. Subtus parce punctata.

Ubi præcedens specimen singulum legi.

I have not dissected the labium of this species, which, however, is at once recognized by its depressed and, in proportion to its width, very long shape. The labrum, antennæ and legs are so much like those of the former that they need no further description. The bristle of the ligula appears simple.

9. *Clivina maculata*, N.

C. picea, elytris ferrugineis infra medium macula nigra indistincte ornatis, pedibus intermed. et post. oreque brunneo-testaceis, pedibus ant. antennisque obscurioribus. Long. corp. 2 lin

Caput oblonge quadratum, rugosum, costis 5 magis minusve interruptis, ad marginem anteriorem dentibus 4 productis munitum. Palpi art. ultimo basi intus incrassato. Antennæ art. 2-3 subæqualibus. Thorax subquadratus, leviter rotundatus. Elytra striata, in striis profunde punctata.

Ubi præcedentes specimen singulum legi.

As distinguished as the two preceding species. The palpi and the mentum appear to me of a somewhat extraordinary form. The last joint of the former is considerably more inflated at the base than in any other Ceylon species that has hitherto come under my notice, whilst the others are of a very curved appearance in both the maxillary and labial palpi. The emargination of the mentum would at first sight appear to be of semilunar shape; however, it is only the lower margin which has this form, the oblique truncature which forms the emargination being such as to give it that shape. The tooth is but of the typical shape, standing on a level with the lower margin; it stands at a small angle with respect to the inclined plane formed by the rest of the truncature. The apical angles of the lobes are somewhat pyramidal, being formed by three sides. I have not dissected the labium, and therefore do not know whether the remaining parts exhibit any peculiarities. The insect is, however, easily distinguished by its general facies, which is rather like that of a *Dyschirius*, from which genus, however, the mentum alone is sufficient to separate it. I may as well remark here, that, although the island is well supplied with Scarites and Clivinas, I have hitherto not discovered a single *Dyschirius*, a genus so well represented in Europe. Of the three Clivinas just described, single specimens only have been in my possession for a considerable time. There are three or four more species met with about Colombo, but these being of common occurrence, I abstain from describing them here, as they may possibly be amongst those described by Putzeys or others from the Indian continent.

Family RHIPIPHORIDES.

10. *Rhipiphorus tropicus*, N.

R. niger, nitidus, elytris albidis, nigro-maculatis, labro, palpis, antennis (pectine nigrescente excepto), unguibusque brunneis, impresso-punctatus, punctis magnis sed non profundis, subtus suborbicularibus piliferis, supra oblongis, lævibus. Long. corp. $2\frac{1}{2}$ lin., lat. ad humeros $\frac{3}{4}$ lin.

Caput oblongum, latitudine paulo longius, parte frontis inferiore dense profundeque punctata, vertice obtuse obconico, glabro, nitidissimo, occipite piloso. Thorax elevatus, ad basin 2-impressus, medio angulo obtuso, apice excavato, glabro, inter elytra producto. Elytra ad suturam utrinque stria lata brunnea punctata impressa, acuminata, apice dehiscentia, albida vel subhyalina, apicibus, medio utrinque et ad basin nigro-maculata. Alæ apice fuscae. Pedes tarsis anticis art. 2-4 unguibusque bifidis, omnibus brunneis, tarsis subtus setosis, anticis, art. 2-3 primoque apice, subtiliter sericeo-penicillatis.

Specimen singulum m. prope Colombo in floribus legi. De metamorphosi adhuc nihil constat.

The head is rather long in proportion to its width; the occiput is narrowed, short obconic. The hind part of the thorax is elevated above the elytra; the central part of its base is prolonged between the elytra in an obtuse angle, the apex of which is abruptly truncated, excavated and polished. The labrum is hairy, and the ungues of the tarsi bifid as usual.

The tibiae of the anterior legs are furnished at the apex with one, those of the four posterior legs with two spurs. The anterior tarsi have joints 2-4 brown. The tarsi are setose below joints 2-3, the apex of the first of the anterior ones wearing fine yellowish silky brushes instead.

All over the island the Rhipiphorides and Mordellina appear to be very scarce, with the exception of one or two species of *Anaspis*, which are not seldom taken in flowers. Still I recollect having met with about seven species, including two large Mordellas, which, however, I have not been fortunate enough to catch as yet.

Family STAPHYLINIDÆ.

Tribe PINOPHILINI.

11. *Edichirus alatus*, N.

Æ. alatus, setosus, nitidus, rufo-testaceus, thorace dilutiore, capite, elytris abdominisque segmentis 3 ultimis nigris; elytris apice 2-maculatis, maculis rufo-testaceis; pedibus flavis, femoribus apice tibiisque basi nigrescentibus; antennis palpisque maxill. basi obscuris, apice testaceis, reliquis oris partibus rufo-piceis. Long. corp. $3\frac{1}{2}$ lin.

Æ. Paderino Erichs. similis, præter colorum distributionem differt tamen *alis*, elytrorum sculptura, antennarumque articulo ultimo. Antennæ art. ultimo penultimo æquali nisi paulo minore, apice fortiter *truncato* leviterque excavato. Thorax *Æ. Paderini*, dorso punctis biserialim impressus, serie interna vel centrali elliptica punctis minoribus magis inter se approximatis, externa vel submarginali punctis magnis distantibus. Elytra oblonge subquadrata, infra medium rotundata, thorace *longiora* et fere duplo ampliora (utrumque elytron thoracis fere magnitudine), basi parte thoracis adjacentem *duplo*—infra medium illius latitudine antica plus tertia parte latiora. Os, pedes et abdomen *Æ. Paderini*.

Paderorum more victitare videtur; in eorum societate in lacus Colombensis ripis infrequentissime legi; illis minus gracilis atque minus agilis.

I have not had an opportunity of examining specimens of either of the three *Edichiri* hitherto described. However, I have before me Erichson's figure and description of the Sicilian *Æ. Paderinus*, with which I find my species strongly to agree.

It differs, however, from it materially in the following three points, viz. the wings, the sculpture of the wing-covers, and the last antennal joint. The fact that this species has wings would render an alteration in Erichson's diagnosis of the genus necessary, it being characterized by him as apterous. The elytra are not so much contracted and rounded at the base, and, being longer than the thorax, have therefore a more oblong, subquadrate appearance; as in the above typical species, they are, however, rounded at the sides and broadest a little below the middle; they are about twice as broad at the base as the adjoining part of the thorax, and in their broadest part rather more than a third wider than the broadest part of the thorax. The third point in which the two species differ is the last joint of the antennæ, which in this case is strongly truncated at the tip and slightly excavated. They are further distinguished by the distribution of the colours: my species being of dark yellowish red, thorax lighter; head, elytra, and three last abdominal segments black; elytra with two reddish spots at the apex; legs yellowish, at the apex of the femora and base of the tibiæ blackish; the mouth is brown; the maxillary palpi yellowish, with the three first joints dark at the base; the antennæ have the six basal joints dark excepting at the apex, where they, as well as the five remaining ones, are yellowish. In all other points I find the insect to agree entirely with the typical *Æ. Paderinus*: the palpi, legs, and anal segment of the abdomen are of the same structure; the hairy vestiture is exactly the same in the different parts of the body of my species as it is in the corresponding ones of Erichson's.

It is perhaps wrong in me to describe an isolated species of

this extensive and difficult family. However, the genus *Edichirus* is one so extraordinary, that I am sure it will be noticed wherever the description of a new species of it may be found, be it by itself or amongst those of other Staphylinidæ. The case would be different if the object of the description were a *Homalota* or the like.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

December 18, 1856.—The Lord Wrottesley, President, in the Chair.

“On the *Scelidotherium (Scelidotherium leptocephalum, Owen)*, a large extinct Terrestrial Sloth.” By Professor R. Owen, F.R.S.

The extinct species of large terrestrial Sloth, indicated by the above name, was first made known by portions of its fossil skeleton having been discovered by Charles Darwin, Esq., F.R.S., at Punta Alta, Northern Patagonia. These portions were described by the author in the Appendix to the ‘Natural History of the Voyage of H.M.S. Beagle.’

The subsequent acquisition by the British Museum of the collection of Fossil Mammalia brought from Buenos Ayres by M. Bravard, has given further evidence of the generic distinction of the *Scelidotherium*, and has supplied important characters of the osseous system, and especially of the skull, which the fragments from the hard consolidated gravel of Punta Alta did not afford.

The best portion of the cranium from that locality wanted the facial part anterior to the orbit, and the greater part of the upper walls; sufficient however remained to indicate the peculiar character of its slender proportions, and hence Professor Owen has been led to select the name *leptocephalum* for the species, which is undoubtedly new.

The aptness of the epithet ‘slender-headed’ is proved by the author’s researches to be greater than could have been surmised from the original fossil; for the entire skull, now in the British Museum, exhibits a curious and very peculiar prolongation of the upper and lower jaws, and a slenderness of the parts produced anterior to the dental series, unique in the leaf-eating section of the order *Bruta*, and offering a very interesting approximation to the peculiar proportions of the skull in the Ant-eaters.

The original fossils from Patagonia indicated that they belonged to an individual of immature age: the difference of size between them and the corresponding parts in the British Museum, depends on the latter having belonged to full-grown individuals: the slight difference in the shape of the anterior molars seems in like manner to be due

to such an amount of change as might take place in the progress of growth of a tooth with a constantly renewable pulp. Professor Owen finds at least no good grounds for inferring a specific distinction between the mature if not old *Scelidothera* from Buenos Ayres, and the younger specimen from Patagonia.

The author then proceeds to give a detailed anatomical account of the fossil bones in the British Museum, instituting a comparison between them and the bones of other large extinct animals, especially those of the *Edentate* order.

The *Scelidothera* was a quadruped of from 8 to 10 feet in length, but not more than 4 feet high, and nearly as broad at the haunches; the thigh-bones being extraordinarily broad in proportion to their length. The trunk gradually tapered forwards to the long and slender head. The fore-limbs had complete clavicles, and the rotatory movements of the fore-arm. All the limbs were provided with long and strong claws. The animal had a long and muscular tongue, and it is probable that its food might have been of a more mixed nature than that of the *Megatherium*. But it was more essentially related to the Sloths than to the Ant-eaters.

In conclusion the author remarks, that as our knowledge of the great *Megatherioid* animals increases, the definition of their distinctive characters demands a more extended comparison of particulars. Hence in each successive attempt at a restoration of these truly remarkable extinct South American quadrupeds, there results a description of details which might seem prolix and uncalled for, but which are necessary for the proper development of the task of reproducing a specimen of an extinct species.

Professor Owen adds, that he is indebted to an allotment from the Government Grant, placed at the disposal of the Royal Society for scientific purposes, for the means of laying before the Society large and admirably executed drawings of the fossil bones described in his paper.

January 29, 1857.—Major-General Sabine, Treas. and V. P., in the Chair.

“On the Nervous System of *Lumbricus terrestris*.” By J. Lockhart Clarke, Esq., F.R.S.

In the summer of 1855, with the view of throwing some light on other researches in human anatomy, in which he was already engaged, the author undertook some anatomical inquiries on the nervous system of Invertebrata; but finding them occupy more time than he could spare, he was compelled to relinquish the pursuit after having made many interesting but desultory observations on various animals. As he had proceeded, however, to a considerable extent with the nervous system of *Lumbricus terrestris*, and discovered in it much that is important and was hitherto unknown, he has thought it expedient to resume and complete this portion of the subject without further delay.

Before treating of the nervous system it was necessary—in order to show the proper functions of many of its parts—to give some account of the organs of prehension, deglutition and digestion; and as these are insufficiently explained elsewhere, the author has described them entirely from his own dissections and observation.

The first anterior segment is a conical or nipple-shaped projection inserted behind into the upper fifth of the second segment, or first ring. Its dorsal surface is covered, except in the centre, by concentric laminæ and irregular masses of pigment-granules, which are interspersed with large, peculiar and nearly pellucid cells. Its under part forms a soft and delicate pad, or upper lip, and is continuous at the sides with the inferior half of the second segment, or under lip, to complete the oral orifice from which the mucous membrane of the mouth is reflected inwards. The mouth is a wide tube surrounded by a delicate muscular coat, and attached to the outer tube, or rings, by fine muscular bands. Behind, it dilates into a capacious heart-shaped sac, of which the roof or upper wall is covered by a thick oval muscular mass. The outer portion of this mass is divided into distinct, radiating, digital muscles which connect it on all sides and are continuous with the longitudinal muscles of the rings. Its inner surface projects anteriorly into the cavity of the pharynx, in the form of a thick circular disc or sucker, surrounded by loose folds of mucous membrane. Opening into the sides of the mouth and pharynx are two or three sets of salivary glands, which consist of convoluted tubules, resembling those of Lepidopterous insects: these glands have not been hitherto detected in *Lumbricus terrestris*. The pharynx contracts into a comparatively narrow œsophagus, which in its turn dilates into a capacious crop; and this immediately opens into a cylindrical gizzard composed of a ring of cartilage, with an external muscular coat, and a lining of mucous membrane. A long straight and narrow intestine extends through the rest of the body, and is covered throughout with yellow, follicular, hepatic glands in circles corresponding to the segments.

Nervous System.—The central organs of the nervous system consist chiefly of a bilobed cephalic ganglion, and a double chain of sub-ventral ganglia extending through the whole length of the body. The lateral lobes of the cephalic ganglion are pyriform, and united by their broader ends in the mesial line. The small end of each divides into two nerve-trunks, of which one forms the root of its cephalic nerves, and the other, the pharyngeal crus, which curves round the side of the pharynx to join the first subventral ganglion. Each crus gives off eight or nine branches. The first four or five arise from the under part of its anterior half, and immediately enter the upper surface of a minute and delicate cord-like chain of ganglia, the enlargements of which correspond to them in number and size. This highly interesting structure lies on the side of the pharynx, concealed beneath the crus. The breadth of its first ganglionic enlargement in a good-sized worm, was the $\frac{1}{16}$ th of an inch; that of the last the $\frac{1}{16}$ th; the pharyngeal crus, where their roots come off, was $\frac{1}{16}$ th of an inch in diameter. Each border of the chain gives off

several trunks of considerable size, which immediately communicate to form a continuous plexus. The part of the plexus on the inner side is much the larger, and supplies anteriorly, the muscular and mucous coats of the mouth as far as the lips; and posteriorly, the pharynx and suctorial disc; uniting in both directions with its fellow of the opposite side. The outer part supplies the muscular bands and salivary tubules. From the pharynx, the plexus descends along the side of the œsophagus, lying on the abdominal vessels, and communicates with minute filaments from the nerves of the subventral ganglia.

The whole of this little chain with a large portion of its plexus and the wall of the pharynx on which it lies, was removed and examined under a $\frac{1}{4}$ -th-inch object-glass, when a beautiful and unexpected appearance was observed. The under surface of the *entire* chain—cords as well as ganglia—was covered with a lamina of round, oval, and pyriform cells; and on its upper surface a row of cells of the same kind was found along each border. At every point of communication between the branches which form the plexus, a minute ganglionic enlargement was observed, from which new branches proceeded to form other enlargements of the same kind. Every branch communicated by loops with those adjacent, and by transverse fibres with those of the opposite side, giving to the ganglionic points a kind of stellate appearance. In these microscopic ganglia, the nerve-cells, similar to those of the chain, were accumulated chiefly about the angles, along the borders, and extended some distance into the principal trunks; but very few could be seen in connexion with nerve-fibres, which ran around and between them, however, in an intricate manner. As the plexus extended from the chain, the ganglionic points diminished in size, while the smaller branches given off from the trunks increased in number, and communicated like a capillary network. At the same time the ultimate fibres became paler, flatter, more parallel, and acquired nuclei like those of cells. This was particularly observed in those distributed to the mucous membrane. The above observations were repeated on nearly forty different specimens.

On considering the parts which it supplies, this little chain appears to combine the office of a sympathetic with certain other functions which in many Invertebrata are entrusted to separate and special centres;—such as the labial, pharyngeal, and visceral ganglia in Cephalopodous and Gasteropodous Mollusca, and the separate parts of the stomato-gastric system of Insects, which, although derived from different sources, are in intimate communication with each other. The lateral ganglia in Insects have the same position as the little chain of *Lumbricus*, on the side of the pharynx, which, according to Mr. Newport, is supplied entirely by them; they arise, however, wholly from the cephalic ganglion, while the chain in *Lumbricus* has just been seen to take its origin both from this and the pharyngeal collar, but then, in orthopterous insects, the gangliated recurrent nerve, which is always in intimate connexion with the lateral ganglia, arises entirely from the pharyngeal crus; and the fact has been observed by Burmeister, Brandt and Müller, that in some other orders

these two parts, in regard to size, are in the inverse ratio of each other. In Crustacea also, the whole of the pharyngeal, gastric and visceral nerves take their origin from the crura, as was first shown by Audouin and Milne-Edwards.

The second set of nerves from the pharyngeal collar come off from its posterior half, and communicate with each other by loops before they leave it. The first and largest sends some filaments to the muscular bands of the mouth, upon which they communicate by evident but slight dilatations with the plexus of the pharyngeal chain; and after supplying the muscles of the anterior segments, are lost in the integument of the lower lip. The rest take nearly the same course. But what is extremely interesting, the roots of this set—at least of the first and second branches—are continuous across the crus with those of the former set which belong to the pharyngeal chain; and many of their fibres may be traced not only into its ganglia, but through the trunks which proceed from their opposite sides to form the pharyngeal ganglionic plexus; so that the nerves distributed to the labial muscles and integument of the outer tube, and those which supply the inflected oral and pharyngeal tube, are in direct continuity, not only at their peripheral extremity, but at their roots also, through the common centre which presides over the whole of the digestive apparatus. A similar connexion will be seen to exist with regard to the cephalic nerves.

The *subventral chain* is a double cord gangliated at short intervals by the addition of vesicular substance. Anteriorly the cords are separate and continuous with the pharyngeal crura of their respective sides; but through the rest of their course they lie in close contact along the middle line. The ganglionic enlargements vary somewhat in size, shape, and approximation at different parts. The vesicular substance is on their under surface, and consists of about two strata of cells continuous in a lamina across both cords. Along their borders, however, the cells form a thicker layer or column, which extends for some distance along the intervening cords. In form and general appearance the cells are similar to those of the pharyngeal chain, but many of them are larger. Those of the first ganglion extend into the lower parts of the crura, and are continuous behind with the lamina of the second. Each ganglion gives off from its sides two pairs of nerves, which, after sending some filaments to the septa and muscular bands, supply the longitudinal, oblique and circular muscles of the rings. Midway between the ganglia, the intervening cords give off a single pair, which are distributed to the deep muscles on each side. Within the ganglia the roots diverge in three different ways:—1, longitudinally; 2, transversely; and 3, to the grey or vesicular substance. The first or longitudinal form a large portion of the nerves, and run in equal numbers in both directions—backwards and forwards,—along the whole breadth of the corresponding cord. In their course, some of them, near the border, separate in succession from the rest and enter the lateral columns of cells; others proceed as far as the next nerve, with the roots of which they form loops, and pass out, while the rest continue onwards and, perhaps, in suc-

cession form similar loops with distant nerves. In former communications to the Royal Society, the author has shown that the same kind of arrangement exists in the spinal cord of Man and Mammalia.

The second or transverse order of fibres are less numerous, and in general less distinct than the last. They proceed from the middle of each opposite root, and cross the cords directly; but some of them, on reaching the opposite cord, turn round in both directions, and run with its longitudinal fibres. In front of the first ganglion, in which they are unusually distinct, a separate band unites the roots which descend from the branches arising from the opposite crura of the pharyngeal collar.

The third order of fibres, or those distributed to the vesicular substance, spread out in all directions, but always—except in the lateral layers or columns—beneath the superficial stratum. After nearly fifty separate examinations, with all the resources of the microscope, the author has not been able, in more than two or three instances, to trace an undoubted continuity between the cells and nerve-fibres. Fibres in abundance may be seen in connexion with the cells, but the greater number of these are not nerve fibres. Nevertheless, there is reason to believe that such a connexion does frequently exist, but is obscured by certain peculiarities of structure. Still it is quite certain that a vast number of fibres pass by or around the cells near their origin, and many often appear to terminate in loops.

Cephalic Ganglion.—This rests on the commencement of the pharynx, beneath the dorsal part of the third ring. Each lobe is a pyriform sac, which is very thick and convex posteriorly, where it is partially separated from its fellow by a deep notch. This convex portion is opaque-white, and filled with a mass of semifluid granular substance, and oval, round and pyriform cells, of various sizes, but often very large. Some of the latter kind are exceedingly elongated. The anterior half, by which the lobes are joined, is merely lined with a lamina of cells, and only at its upper part, its under side having a cell here and there. The interior of this portion is entirely fibrous, and consists of a broad transverse commissural band derived from the pharyngeal collar, and of fibres from the roots of the cephalic nerves. Each crus of the collar enters its lobe on the under side. Some of its fibres curve backwards to the convex vesicular mass; others ascend to—perhaps partly terminate in—the cells near the roots of the cephalic nerves; and the rest cross transversely as the broad band, to be continuous in front of the notch with that of the opposite crus. The cephalic nerves are attached to the upper part of the ganglion. Many of their roots cross transversely with the crural band, to form loops with those of the opposite lobe. Decussating these, a considerable number run down the pharyngeal crus, and enter the pharyngeal chain of ganglia through its first and second roots, at least,—perhaps through all,—and probably form loops with the other set of branches of the crus. The remaining fibres of the cephalic nerves spread through the vesicular substance, partly describing curves and undulations in the corresponding lobe, and com-

municating in part with the other in the mesial line, where they form a kind of indistinct decussation in front of the notch.

Distribution of the Cephalic Nerves.—Their roots on each side immediately separate into two trunks, a lower and upper. The former runs above the mouth, to the under side of the first conical segment, or upper lip. Here it divides into several branches, which supply its muscular bands, and then terminate in the integument as a plexus, which appears to communicate with that from the first enlargement of the pharyngeal chain, spread over the tubular mouth, which is itself continuous with the upper lip. The upper trunk proceeds directly to the corresponding part of the same segment, and there divides into two branches, of which one in particular, after running the course of the pigmentary laminae, and giving off a series of short filaments, terminates at the point, beneath the integument.

In the pigmentary laminae the nerves form an intricate plexus, and the impression was that many of their ultimate fibres end in loops. They were never seen to be directly connected with the large clear cells scattered through the substance. Nor is there any ground for conjecture with regard to the office of these cells: perhaps they are intended for the transmission of light. From the structure of the segment and the distribution of its nerves, it is not unreasonable to think that its upper surface may be instrumental in the perception of diffused light; and that its under surface and point may be subservient not only to the sense of touch, but perhaps also to that of smell, in a low degree. That it forms an important organ of search, is pretty evident from the manner in which it is projected alternately forwards and from side to side, as the animal advances in its course.

The upper side of the cephalic ganglion corresponds to the under side of the subventral, and several points of resemblance are indicated between the two kinds of centres. Each pharyngeal crus is shown to be a compound structure, composed of different sets of connecting fibres,—1, between its own nerves, which supply, on the one side, the cephalic portion of the outer tube, and on the other, the corresponding part of the alimentary tube reflected inwards from the former; 2, between these nerves and their fellows of the opposite crus, across the front of the first ganglion; 3, between the same nerves and the cephalic ganglion; and 4, between the cephalic ganglion and the same side of the whole subventral chain. Now there is this point of *difference* between the two kinds of centres compared together,—that while the last-mentioned set of fibres on the one side is continuous with that on the other, as a transverse band through the cephalic ganglion, the subventral cords, although continuous with these on their respective sides, form no such connexion with each other across the lateral halves of their own ganglia, but run parallel and directly *backwards* through them. Such a communication, however, is established for the latter, individually, by the transverse fibres of their *own nerves*; and just as these fibres unite the lateral halves of each *separate* ganglion, *independently of the cephalic*, so do the last-mentioned set of fibres of the crura con-

nect together the two lateral halves of the *entire chain in and through* the cephalic ganglion, which is their dominant and controlling centre.

Two parts of the human brain may be compared to this transverse cephalic band. One is the arched and commissural band of fibres prolonged through the corpora quadrigemina, from the upper and inner part of the fillet on each side. But the outer part of the fillet turns forwards and upwards beneath the corpus geniculatum internum and optic tract, to enter the optic thalamus. It is not improbable, therefore, that some of the fibres of the tract may descend along this portion of the fillet, to form loops with the roots of the fifth nerve, over which it passes, since in *Lumbricus* it has been seen that many of the roots of the cephalic nerves run down the pharyngeal crus to form loops with others to which it gives origin. In a former memoir by the author, it was shown that some of the roots of the spinal accessory nerve reach the anterior grey cornu and mingle, perhaps pass out with, the spinal roots; and he has since observed the equally interesting fact, that the same nerve forms a similar connexion with the vesicular nucleus of the hypoglossal, which may be considered a representative of the anterior spinal. The spinal-accessory, therefore, takes its origin from at least three different sources,—from its own nucleus, and from the nuclei of the hypoglossal and anterior spinal nerves. The peripheral communications of both the former with the latter nerves in the cervical plexus is well known. The author believes he has also made out an intimate connexion by loops between at least the portio intermedia of the seventh and the large root of the fifth nerves within the substance of the human medulla.

The other part of the human brain which is analogous, or homologous with the cephalic band of *Lumbricus*, is the corpus callosum. Gall and others have thought that the fibres of this structure arise from the grey substance of the hemispheres; while some have endeavoured to show their continuity with those of the crura cerebri. Now it is quite certain that in the cephalic ganglion of *Lumbricus*, a large proportion of the commissural fibres are directly continuous with those of the pharyngeal crura; and there are appearances which favour the conclusion that some of the latter are confined to the lobe on their own side. From *analogy*, then, we may infer, that while a large portion of the crura cerebri are directly continuous with the corpus callosum, some of their fibres *probably* terminate in the cerebral convolutions of the corresponding side.

From what has been shown, it is evident that the communications between the roots of nerves are more intimate and extensive than they were hitherto believed to be; for it has been seen that the roots not only of every spinal nerve, but of every other in the system, communicate with those which *correspond* on the *opposite*, and with those which are *adjacent* on the *same* side. Of the cephalic with the two sets from the pharyngeal collar, and of the latter with each other, the connexions are particularly interesting, and may serve as guides to future investigations on other forms of the nervous system.

By experiments that were made on the living worm, it is shown that the pharyngeal chain of ganglia are independent of the other nervous centres, although subject to their influence, and are not only competent of themselves to preside over the complicated movements of the suctorial pharynx and mouth, but appear also to be centres of reflex action.

The present memoir concludes with some observations and remarks on the ganglionic cords of other Invertebrata.

“An Account of the two Methods of Reproduction in *Daphnia*, and of the Structure of the ‘Ephippium.’” By John Lubbock, Esq., F.G.S.

In this paper the author describes the male organs and the structure of the Ephippium in the genus *Daphnia*, and the double method of reproduction by agamic and ephippial eggs. The author calls the non-ephippial eggs agamic, but it is possible, though not probable, that the ephippial eggs may be agamic also. In the male *Daphnia* there are two small papillæ above the posterior claws, but on the ventral side of the anus, and on these being compressed, two streams of minute rod-like bodies, with movements so gentle as to be scarcely visible, will be seen to issue, one from each papilla. Nothing similar has ever been observed in the female; nor has any other sort of spermatozoa ever been met with. These male organs have never been described before.

The author then proceeds to describe and figure the two sorts of eggs in their earlier stages, which have not yet been mentioned by any naturalist. The ephippial eggs differ from the agamic in their determinate position and number. As a general rule, that is to say, in seventeen cases out of twenty-three, the author has remarked that ephippial eggs commence and are developed to a certain point.

The development is as follows. One of the ovarian cells, always at the posterior part of the ovary, swells a little, and becomes a germinal vesicle; round it are deposited a number of brownish granules, while the other cells which may at first have existed in the same ovarian mass cease to be visible. The deposition of dark granules, in thirty-seven cases out of forty, after proceeding to a certain point, ceased, and the embryo egg gradually disappeared. In the other three cases it increased, and at length formed a dark mass on each side of the intestinal canal. The author in two cases observed the ephippial eggs pass from the ovary into the receptacle.

The ephippium has been described by Strauss with considerable accuracy, but he has been more or less misunderstood by all subsequent writers on the subject, and no one has explained the homologies or connexions of the inner valve. The ephippium itself is a locally altered portion of the carapace; the outer valve of the ephippium being a part of the outer layer of the epidermis, and the inner valve the corresponding part of the inner layer. In consequence of this arrangement, the inner valve of the ephippium, containing the ephippial eggs, is not attached by the hinge to the outer valve, as has been generally stated, but actually lies at first in

the receptacle formed by the new carapace. The ephippium is cast with the rest of the skin, from which however it soon becomes detached, and continues to form an efficient protection to the eggs until they are hatched. These eggs probably require to be fertilized, but this fact is not completely proved. With one exception, whenever the author observed ephippia, he could also find males; and, generally speaking, the numbers of each were in proportion to one another. Impregnation is not, however, absolutely necessary to the production of ephippia, as the author has now in his possession three ephippia, formed by isolated females. It remains to be seen whether young will be developed from these or not.

The early stages of the agamic egg are very similar to those of the ephippial egg, and consist of the enlargement, in the front part of the ovary, of one of the ovarian cells, which then becomes a germinal vesicle, and the deposition round it of granules, with the addition in this case of oil-globules. This process continues, the other two or three cells which may have existed in the same ovarian mass gradually disappear, and there is thus formed an egg-like mass, consisting of a germinal vesicle, minute dark granules, and large oil-globules. When the growth is nearly completed, the vitelline membrane is added. This is at first very delicate, but after deposition in the receptacle soon becomes hard. The ovarian eggs of *Daphnia*, as well as those of *Cypris*, never contain round masses like those of *Aphis* and *Musca*; but after their entry into the receptacle, yolk-masses are found, homologous with those present at the corresponding periods in *Phryganea**. The eggs when laid are about $\frac{3}{8}$ of an inch in diameter; they gradually become $\frac{1}{8}$, when the vitelline membrane splits and falls off, and the young animal is hatched. Far, however, from resembling its parent at this time, the young *Daphnia* is a spherical bag, inside which the formation and development of the new organs is rapidly progressing†. Instead therefore of undergoing no metamorphosis, the young *Daphnia* only assumes the well-known characters of the genus after the first changes of skin. The author proceeds to compare this phenomenon with a similar one observed by Mr. Spence Bate in *Gammarus*, by Prof. Huxley in *Mysis*, by Dr. Cohn in *Sphaeroplea*, in many Annelids, and in the interesting entozoon *Monostomum mutabile*. The young *Daphnia* attains a length of .025 inch before it leaves the receptacle of the mother, but the length of time during which it remains therein varies according to the temperature. The author has never met with an exception to the rule noticed by preceding writers, that unisexuality is characteristic of an agamic brood.

It follows from these observations, that the self-fertile *Daphniæ*

* The round balls described by Herold in the ovarian eggs of *Bombus*, appear to be of a different nature, and homologous with the Nahrungsdotter mentioned by Carus in spiders' eggs and the oil-globules of *Daphnia*.

† It is worthy of notice, that the back fold indicating the divisions between the head and body is opposite the line between the mandibles and the first pair of maxillæ, which latter appear therefore to belong to the body, as Zaddach also asserts, and not to the head.

are certainly true females, and that the reproductive bodies more nearly resemble eggs than gemmæ in their origin and development. Hereafter, however, it may be convenient to give a separate name to those egg-like bodies, which are fertile without impregnation, but for the present they must be called eggs.

The author then gives a list of the instances of Parthenogenesis which, so far as he knows, are recorded among the Articulata. Finally, he expresses the belief that the careful consideration of these cases, and of the facts now recorded as to *Daphnia*, and the still more wonderful observations recently detailed by Siebold in regard to *Apis* (if these latter are confirmed), must surely remove all lingering doubts as to the identity between eggs and buds; and remarks, that if Prof. Huxley's definition of "individual" and "zooid" is to be adopted, it will be impossible to assert of any *Daphnia* or Moth, whether it is the one or the other, and the Hive-bee will have to be considered as an hermaphrodite, a species without male individuals.

Under these circumstances, the author suggests that it would be more convenient to continue, as heretofore, to call the individual of any species that which is individualized, even though in this case the individuals of one species will not always be homologous with those of another.

BOMBAY BRANCH OF THE ROYAL ASIATIC SOCIETY.

November 13, 1856.—W. E. Frere, Esq., C.S., President, in the chair.

"Transformation of the Vegetable Protoplasm into *Actinophrys*." By H. J. Carter, Esq., Assistant Surgeon H.C.S. Bombay.

The author stated, that when he first entered upon the study of the Infusoria and freshwater Algae, he had no idea of any union existing between the two, further than that of a gradual approximation of form and organization: and that he was opposed to any sudden leaps from the animal into the vegetable kingdom or *vice versa*, might be seen by the facts which he had brought forward, in attempting to account for the transformation that takes place in the *Characeæ* when the contents of their cells undergo the changes which he had described on a previous occasion (*Annals*, vol. xvii. p. 101, &c.). But latterly his opinions had altered, and he was now compelled to view these transformations as a direct passage of the protoplasm into Monads.

The process which ends in this development had been called by Nägeli "abnormal cell-formation," and Nägeli thought that in some instances germs were thus produced which propagated the plant. Nor could Pringsheim come to any other conclusion than that they were reproductive in *Spirogyra*, where he had more particularly observed them; while the philosophic Alexander Braun, after recapitulating all that had been made known on the subject in his 'Rejuvenescence in Nature,' adds, "the future will certainly unfold many interesting phenomena in this hitherto little-worked field."

Before detailing his observations on this development in *Spirogyra*

which had led to the view above mentioned, the author had thought proper to premise a short account of analogous transformations in *Vorticella* and *Euglena*. In confirming most of what Stein had stated, respecting the passage of *Vorticella* into *Acineta*, he observed, that he had never seen the young of the latter assume any other form than that of *Acineta*, but he had witnessed *Amœbæ* in the act of throwing off living *Vorticellæ*. The passage of the contents of *Euglena* (which organism was much more allied to the vegetable than the animal kingdom) into Rhizopods was a common occurrence, and so nearly resembling that which takes place in *Spirogyra*, that it formed a good transitional link, perhaps, between the passage of *Vorticella* on the Infusorial, and the contents of the cell of *Spirogyra*, on the Alga side, into Rhizopodous animalculæ.

It was in the cell of *Spirogyra crassa* (Kg.) (the largest perhaps of the genus), however, that Mr. Carter had latterly been watching these transformations, and it was to these more particularly that he wished to direct attention. The process was simply this:—

Under certain circumstances the cell of *Spirogyra* apparently dies, the chlorophyll becomes yellow, and the protoplasm leaving its natural position divides up into portions of different sizes, each of which encloses more or less of the chlorophyll; these portions travel about the cell under a Rhizopodous form, the chlorophyll within them turns brown, the portions of protoplasm then become Actinophorous, then more radiated, and finally assume the figure of *Actinophrys*. The radii are now withdrawn, while the pellicula in which they were encased is retracted and hardened into setæ with the rest of the pellicula, which now becomes a lifeless transparent cyst; another more delicate cyst is secreted within this, and the remains of the protoplasm within all having separated itself from the chlorophyll, divides up into a group of monociliated Monads, which sooner or later find their way through the cysts into the cell of the *Spirogyra*; while the latter by this time having passed far into dissolution (not putrefactive), they thus easily escape into the water. Putrefactive decomposition at the commencement destroys this process altogether.

At first it did not appear plain why the portions of protoplasm enclosed the chlorophyll, but afterwards it was found that this was for the purpose of abstracting the starch which accompanies the latter, since in some cases where the grains of starch were numerous the chlorophyll was not included.

This was the process when the cells of *Spirogyra* were not pregnant with starch, as they are just before conjugating. When these changes took place at this period they were somewhat different, inasmuch as the whole of the contents of the two conjugating cells become united into one mass, and having assumed a globular form, remain in this state until the chlorophyll has become more or less brown. After this the protoplasm reappears at the circumference of the mass in two forms, viz. in portions which leave the mass altogether after the manner of Rhizopods, and in the form of tubular extensions which maintain their connexion with the mass throughout. In both instances the protoplasm is without chlorophyll, but charged with oil-

globules, and both forms make their way to the confines of the *Spirogyra*-cell, which they ultimately pierce, develop their contents, and discharge them in the following manner:—

On reaching the cell-wall, each form puts forth a minute papillary eminence, which, having passed through the wall, expands into a large sac, or bursts at its apex. Following the isolated form first, this then gradually drags four-fifths or more of its bulk through this opening, sometimes so much as only to leave a little papillary eminence in it, which then makes the portion of protoplasm look as if it were entering instead of escaping from the *Spirogyra*-cell; the internal contents of this protoplasm then become more defined and granular, the granules assume a spherical form respectively, they evince a power of locomotion, and the originally flexible pellicula having become a stiffened cyst, with a more delicate one within (as in the process already detailed), assumes a slightly conical form, which giving way by a circular aperture at the apex, allows the granules to pass into the water, when they are seen to be monociliated Monads; each consisting, apparently, of a film of protoplasm expanded over an oil-globule, and bearing a single cilium. The contents of the tubular form, on the other hand, undergo the same changes, but the tube becomes dilated into a pyriform shape within the *Spirogyra*-cell; and when the Monads are ready to lead an independent existence, the end of the papillary eminence, which has been projected some little distance beyond the cell-wall into the water, gives way, and thus they also escape.

In another form of this tubular extension, the inner delicate cyst expands into a flask-like or globular shape, beyond the papillary eminence, outside the cell-wall, and retains the protoplasmic contents here until they are ultimately developed into Monads. These, which are much larger than the Monads developed by the other processes, on issuing, move about rapidly for some time by the aid of a strong cilium carried in front like that of *Astana*, and then become stationary; the vesicula or “contracting vesicle,” which does not appear before they leave the cyst, now becomes very active, the cilium is gradually diminished in size and altogether disappears, and the Monad passes into a Rhizopodous, reptant state, which afterwards becomes Actinophorous, and finally assumes a form undistinguishable from that of *Actinophrys Sol.*

Up to this point the author had been able to follow this transformation, and although he had not actually seen the Actinophorous form enclose particles of food, yet he deemed the form itself sufficiently significant to guarantee this induction, since he had never witnessed a Rhizopod of the kind without attacking everything living and dead that it could overcome and turn into nourishment; besides, such a form could obtain sustenance in no other way. If this was not satisfactory, it was not difficult to conceive, that what the portions of protoplasm in an Actinophorous form would do within, they would do outside the cell of *Spirogyra*; and it had been shown, in the first process detailed, that inside the cell they enclosed chlorophyll, and finally ejected the refuse in the manner of *Amœba*. Lastly, the Monads which are developed by a similar process in the *Characeæ* are fre-

quently seen to issue from the cysts with portions of the brown chlorophyll in their interior, which, as they are not only monociliated but polymorphic from the commencement, they may be assumed to have enclosed after they had become developed from the purified protoplasm.

The fact of portions of the protoplasm enclosing the chlorophyll for the starch it might contain, had been seen by the author most satisfactorily, in some spores of *Spirogyra*, which were in the anomalous state of being pregnant with grains of starch without chlorophyll, while their contents were undergoing the transformations above described. Here there was no colouring matter to impede the view, and the author had repeatedly seen the disappearance of the starch-grains directly followed by the appearance of oil-globules; the dividing up of the protoplasm into portions each containing oil-globules, and a gradual lessening in quantity of the oil, indicative of its having become assimilated; while the transparency of the spore generally, enabled the observer to see, that the whole of these transformations were effected, not by any foreign organism, but by the protoplasm alone.

It was true that the transformation of the protoplasm of the cell of *Spirogyra* and its movements above detailed, were unlike the phenomena of vegetable life, but the formation of the spore itself in the normal way, and the movements of the protoplasm of the conjugating cells just preceding it, merely required to be studied to bring about the conviction, that one was but a modification of the other.

In the normal way, the protoplasm of both conjugating cells after having become pregnant with starch, (for nutriment during their uterine life as it might be termed,) combined, two cysts formed around this mass, the starch passed into oil, and finally the filament was reproduced without the presence of either,—living as before by endosmosis. In the abnormal way, the chlorophyll died, two cysts were formed around the portions of protoplasm respectively, the starch passed into oil, the refuse of the chlorophyll was thrown off from the enclosed protoplasm in the manner of a Rhizopod, the protoplasm divided up into Monads which came forth as animals, that is, in the form of Rhizopods endowed with the power of locomotion and polymorphism, and thus under a form which does not live by endosmosis, but by the enclosure of crude material from which the nutriment is abstracted by a digestive process, and the refuse finally discharged.

Lastly, the author stated, that whenever a mass of filaments of *Spirogyra* underwent these transformations, the latter were invariably followed by a numerous development of *Actinophrys Sol* of all sizes, to the exclusion at first of almost all other animalcules; and coupling this with the undistinguishable form from *Actinophrys Sol* assumed by the Monads developed by these transformations, he saw no other more reasonable conclusion to come to, than that they were one and the same, and therefore that one source at least of *Actinophrys Sol* was the protoplasm of *Spirogyra*.

Mr. Carter added that these phenomena were easily witnessed,

since it was merely requisite to place a mass of the filaments of *Spirogyra crassa* about to conjugate, in a basin of water, and then watch the changes above mentioned, which would be sure to occur in many of the conjugating filaments; but of course, to be understood, they required a practised eye, or to be pointed out by a person conversant with the subject.

ZOOLOGICAL SOCIETY.

May 13, 1856.—Dr. Gray, F.R.S., in the Chair.

SOME REMARKS ON CRUSTACEA OF THE GENUS *LITHODES*,
WITH A BRIEF DESCRIPTION OF A SPECIES APPARENTLY
HITHERTO UNRECORDED. By ADAM WHITE.

The group *Lithodes*, founded by Latreille upon our well-known, though not very common, spine-covered, empty-bodied *Lithodes Maia*, begins now to become better known. Of the excellent figure of this type of the genus, published by Dr. Leach in his 'Malacostraca Britannica,' it is sufficient to say that it was drawn and engraved by the late James Sowerby, F.L.S., and coloured from his pattern.

A very young specimen, procured by R. M^cAndrew, Esq., F.R.S., during his late Norwegian cruise, shows that in the young state the asperities are rather sharper, and the carapace is decidedly longer in comparison with its breadth, than in the adult state; the arrested development of the pieces forming the tail is characteristic in the adult as it is in the young specimen, 1 inch long, dredged by Mr. Barrett, and presented by Mr. M^cAndrew to the Museum.

Seba (vol. iii. pl. 22. f. 1) has figured a specimen with longer and more divergent terminal horns to the rostrum. As a bad specimen exists of this variety in the Paris Museum, Prof. Milne-Edwards fancies, and with good reason too, that it may prove a distinct species; he has provisionally named it *Lithode douteuse* (Crust. ii. 186); at all events, it is a variety which research may find in this country, for different specimens differ in their degrees of divergence in the horns of the rostrum.

Haan, in his 'Fauna Japonica,' 217. t. 47, has figured the male of *Lithodes Camschatica*, a species first described as *Maia Camschatica* by Tilesius in the 'St. Petersburg Memoirs,' v. p. 336. pl. 5. & 6, the female (1812). This species is named by the Chinese *Sima-gani*—that is, the Insular Crab.

Tilesius tells us that it is found on the shore of Kamschatka, among the rocks, where it conceals itself and keeps sedentary, living upon cuttle-fish (*Sepia octopodia*), and snaring Starfishes and Mollusca. He records that this *Lithodes* fixes itself so firmly and resolutely in a hole of a rock, that you could not draw it out without breaking its shell. He compares the tenacity with which the *Lithodes* is held in the hollow of the rock to the fixedness of the *Echinus mammillaris*.

The same learned naturalist has figured another large species from Japan (218. t. 48) as the *Lithodes hystrix*; it is one which Siebold, in

his 'Spicilegia,' p. 15, had only ventured to regard as the common *L. Maia* (*Lithodes arctica*, Lam., Sieb.). The *L. hystrix*, Haau, is a beautifully distinct species very thickly covered with sharp spines, named by the Japanese, *Jeara-gani*, the prickly crab, or *Aka-onigani*, the Devil's red-crab.

This list completed the number of the group found in the northern hemisphere, up to the publication of *L. (Echinocerus) cibarius*, before alluded to. The species to be described in this paper was found by Mr. Lobb cast ashore after a violent storm on the coast of California; and as it has some peculiarities of structure in its legs, antennæ, carapace and abdomen, distinguishing it from any other, it may be named *Lithodes (Petalocerus)*, from the beautiful petal-like lobes of the antennæ. Before describing it, it may be well to review the species of *Lithodes* found in the southern hemisphere.

Messrs. Hombron and Jacquinot, on D'Urville's 'Voyage au Pole Sud,' discovered a fine species which they named *Lithodes antarctica*, pl. 7-8. f. 9, jun. Dana, too, has described and figured this in the 'Crustacea of the United States Exploring Expedition,' i. 427. pl. 26. f. 15. ♀. He found it at Nassau Bay in Fuegia, where he tells us it grows to a very large size; the exuviae of one, obtained by Mr. Dana, were 8 inches long, and the longest legs were 15 inches in length. He describes the species as abundant in water 6 or 7 feet deep, "where it is observed to creep along the bottom with sluggish motion; they have no legs or appendages fitted for swimming. Colour, dark cherry-red, the carapace with a slight purplish tinge. The long spines that cover the carapace and legs are longest proportionally in small individuals; the right hand is much the stoutest, the second basal joint of outer antennæ with a single longish spine on the outer side" (*loc. cit.* i. p. 428).

We hope that Mr. Despard and his noble band, who are now, or will shortly be, in these seas, will find this and the other, and perhaps new, Fuegian species. Specimens of the young are sometimes found in the stomachs of fishes, as in the case of the half-digested *Lithodes Maia* sent to Dr. Leach by the late Dr. Patrick Neill, and now in the British Museum. It would be well to keep some specimens like this.

Gay in his 'Chili' mentions it (iii. 182) as a native of Chili.

The *Lithodes granulosa*, Hombron and Jacquinot, 'Voy. au Pole Sud,' pl. 8. f. 15, has the beak scarcely projecting at all beyond the extra-orbital angle; the carapace and upper parts of its legs are thickly invested, as in some of the *Canceridae*, with close strawberry-surfaced granules, closely pressed together. It is a small species, evidently very distinct from *Lithodes* and more allied to *Lomis*—it may be called *Paralomis granulosa*. We have it in the British Museum. The figure in the 'Voyage au Pole Sud' is extremely bad, not at all giving correctly the surface of the carapace and legs, which are closely matted with the warts.

Messrs. Edwards and Lucas have published the description of a fine species, said to come from the Southern Pacific, in the Archives du Muséum, ii. 465. pl. 24-27, and given ample details of it. It

is named, from its short legs, *Lithodes brevipes*; its beak is short. In the British Museum we have a specimen.

The *Lithodes verrucosa*, Dana (pl. 26. f. 16. vol. i. pl. 428), was found by that able and active naturalist in Fuegia. The carapace is verrucose throughout.

The *Lomis hirta* of M. Edwards, founded on the *Porcellana hirta* of Lamarck (Anim. s. Vert. v. 229), is an interesting generic form, to which Lichtenstein, in one of his catalogues, had applied the name *Thylacurus*. De Haan, who quotes this, has figured a second species in his 'Fauna Japonica' (219. t. 48. f. 2. & t. Q), under the name *Lomis dentata*:—"tota tomentosa, setis brevibus densis, thoracis margine medio 8-spinoso, pedibus secundis, tertiis et quartis margine antico 15-spinosis, spinis cristam subcontinuum formantibus."

Lomis hirta is abundant on the coast of Tasmania.

LITHODES (PETALOCERUS) BELLIANUS.

The first feature of the curious crab here described is the strawberry-like surface of its carapace, and of the blunt spines with which its legs are covered; the next feature is the subequilateral triangular figure of that carapace; this part is produced above the eyes into a notched projection, with two slight prominences down the middle; this covers up the front part of the head, and conceals a wart-covered spine above the base of the pedicels of the eye, which pedicels are spiny above. The carapace has 3 spines on each side, and 2 tubercles; the first spine is directed forwards, and has one or two indistinct spinelets at its base; the second and third are separated from the first by a considerable sinus, and are near each other; they are directed laterally, but slightly inclined forwards like the other two, and indeed, like the whole of the carapace and the spines on the legs, they are covered with the close warting so characteristic of this species; there are two tubercles on the lateral border, which at its end are united at the base; the anterior is the larger; the hind part of carapace is straight, bending round towards these tubercles and thickened on the edges, one of its monticuli being connected with the hindmost lateral tubercle; the stomach, genital and cardiac regions are covered by a projecting portion occupying a considerable part of the back of the carapace and raised above it; this projecting part is environed by a somewhat lyre-shaped wall, pinched in front on the sides and somewhat notched behind with two deep fossæ placed transversely and connected by a short canal, the base of which is smooth with only a few groups of warts.

The abdomen is very regular and complete for the group, and when additional specimens will admit of its being dissected, its structure promises to be curious; the various parts of it are hardly perceptible in the individual examined; a tolerably regular series of strange, close-placed appendages on its edges, seem, on cursory observation, very curious: there are about 12 deepish fossæ over it, the 2 deepest in the basal portion close to back part of carapace, and almost at right angles to the rest of abdomen, 3 on each side diverging into smaller fossulæ towards the edges, and 4 down the centre.

This fine species is named *Lithodes (Petalocerus) Bellianus* in compliment to the ablest of our British carcinologists, the learned and scientific President of the Linneæan Society, Professor Thomas Bell ; in whose fine collection it is preserved. It is to him I am indebted for the loan of the specimen.

May 27, 1856.—Dr. Gray, F.R.S., in the Chair.

Mr. Gould brought under the notice of the Meeting a portion of the Birds collected by Mr. John MacGillivray, the naturalist attached to H.M. Surveying ship *Rattlesnake*, and lately sent home by Capt. Denham, the Commander of the Expedition. They were obtained on the Fijis, San Cristoval, Isle of Pines, and other islands.

Perhaps the most remarkable of these birds is a species of *Centropus*, which exceeds in size every other member of the genus Mr. Gould has yet seen. The single specimen sent home is not fully adult, as is evidenced by some freshly moulted feathers of the tail and wings differing in colour from the older ones. On account of its large and robust form, Mr. Gould proposes to call this species

CENTROPUS MILO.

Head, neck, mantle and breast tawny-white, remainder of the plumage mottled brown and green ; some of the feathers being brown indistinctly banded with green, while others are entirely green, the mottled hue being that of immaturity, and the green the adult livery : bill black.

Total length, $26\frac{1}{2}$ inches ; bill, $2\frac{1}{2}$ inches long by $1\frac{1}{2}$ deep at the base ; wing, $10\frac{1}{2}$; tail, $14\frac{1}{2}$; tarsi, 3.

Hab. Guadalcanar Island.

Remark.—The specimen is a male. Unlike the other members of the genus, this species has bare orbits, with the colouring of which Mr. Gould is not acquainted.

For a fine species of Fruit-eating Pigeon from the Isle of Pines, Mr. Gould proposed the name of

IANTHÆNAS HYPÆNOCHROA.

Head, neck, breast, and under surface vinaceous brown, with glossy purple reflexions on the back of the neck, and a slight gloss of the same hue on the sides of the neck and breast ; chin, sides of the face and throat white ; all the upper surface, wings and tail dark slate-grey, the margins of the wing-coverts and the feathers of the back and upper tail-coverts glossed with bronzy green ; bill scarlet at the base, yellow at the tip ; orbits naked and scarlet ; feet reddish flesh colour.

Total length, 16 inches ; bill, $1\frac{1}{2}$; wing, $9\frac{1}{2}$; tail, 7 ; tarsi, 1.

Hab. Isle of Pines.

Remark.—This is a fine species, about the size of the common Pigeon of Europe. It pertains to the subgenus *Ianthænas*, the members of which are very nearly allied to the birds constituting the genus *Carpophaga*.

Another Pigeon from the same locality was named

TURACENA CRASSIROSTRIS.

Head, all the upper surface, wings and tail dark slaty black, the feathers of the back margined with a deeper black; a broad band of grey across the lateral tail-feathers near the base, and the outer feather on each side tipped with darker grey; throat greyish white; under surface sooty, washed with grey on the sides of the neck, the breast and centre of the abdomen.

Total length, $14\frac{1}{2}$ inches; bill, $1\frac{1}{2}$; wing, $7\frac{3}{4}$; tail, $7\frac{1}{2}$; tarsi, 1.

Hab. Guadalcanar Island.

Remark.—This is a smaller bird than the Australian *Macropygia phasianella*, has a much thicker bill, and a shorter tail, which organ is moreover of a graduated form.

A fine Lory from San Cristoval was named

LORIUS CHLOROCERCUS.

Head, nape, and a patch on each side the neck black; plumage of the whole of the body fine scarlet, with a broad crescentic mark of rich yellow across the breast; tip of the shoulder silvery blue; wing-coverts yellowish green; outer webs of the primaries and secondaries dark grass-green; inner webs dull black, with a broad oblong mark of scarlet along their basal portions; basal half of the tail scarlet, the remainder grass-green; under wing-coverts and thighs fine blue; bill orange; feet dark brown.

Total length, 10 inches; bill, $\frac{7}{8}$; wing, $6\frac{1}{2}$; tail, $4\frac{1}{2}$; tarsi, $\frac{3}{4}$.

Hab. San Cristoval.

Remark.—This is one of the most beautiful species of the genus, and differs from all its congeners in having the apical half of the tail green.

A new *Hirundo* from Moala, one of the Feejee Islands, was characterized as

HIRUNDO SURFUSCA.

Forehead, chin and throat rufous; crown of the head, all the upper surface, wing- and tail-coverts steel-black; wings and tail dark brown; under surface of the body and under wing-coverts dark fuscous; under tail-coverts steel-black, margined with light brown.

Total length, 5 inches; bill, $\frac{1}{2}$; wing, $4\frac{1}{2}$; tail, 2; tarsi, $\frac{1}{2}$.

Remark.—This is a very remarkable Swallow, resembling in the colouring of its back, throat and forehead the common Swallow of Europe; it is also very similar in size, while it has a much larger bill and a very diminutive and but slightly forked tail, the outer feathers not being produced as in the European bird.

The five birds above described are now deposited in the collection at the British Museum.

Mr. Gould also described a new and very beautiful Pigeon from the Solomon Islands as

LOTRERON EUGENIÆ.

Crown of the head, cheeks, upper part of the throat and ear-

coverts white; centre of the throat and chest of the richest crimson; upper surface and wings green washed with orange; along the shoulder a mark of light grey, and a large spot of grey near the tip of each of the tertiaries, primaries dark slate-grey tipped with orange-brown; secondaries slate-grey bordered with orange-brown, and with a very narrow edge of yellow along the apical portion of the external web; under surface of the body greyish green; under surface of the wings grey; vent washed with yellow.

Total length, about 8 inches; bill, $\frac{3}{4}$; wing, $4\frac{1}{4}$; tarsi, $\frac{3}{4}$.

Hab. The Solomon Islands.

Remark.—The only specimen I have ever seen, and which is unfortunately imperfect, being destitute of tail, was sent to me by Mr. Webster, who had visited the above islands. This beautiful little Pigeon, certainly the most brilliantly coloured of the entire group, has been named in honour of Her Imperial Majesty the Empress of the French.

MISCELLANEOUS.

NEW LOCALITIES FOR RARE PLANTS AND ZOOPHYTES.

To the Editors of the Annals of Natural History.

Southlands House, near Chale, Isle of Wight,
Feb. 4, 1857.

GENTLEMEN,—It may be interesting to some of your readers to know, that *Caberea Boryi* (*vide* Busk's Catalogue of Marine Polyzoa, p. 39), found by Miss Cutler on the coast of Devon a few years ago, growing "in minute tufts upon *Eschara foliacea*," is frequently to be met with in this part of the Isle of Wight, nestling among the roots of old specimens of *Laminaria digitata*. The little bay under the village of Nitou, terminating at the east in Puckaster Point, is an admirable locality for procuring it, as large quantities of Algæ are thrown ashore there after rough weather. One specimen was found last month, on a little shrubby tuft of "*Kallymenia reniformis*," which at this season is obtained here in fruit.

Crinia aculeata and fine *Notamia Bursaria* are also found here; and *Laomedea obliqua* may almost be considered abundant.

If a notice of localities for rare plants and zoophytes is at all acceptable, allow me to mention having found *Naccaria Wiggii* in Douglas Bay, in August last, in fruit. *Sphærococcus coronopifolius* is also not uncommonly cast ashore there; and during a month's stay I found five or six specimens of *Callithamnion Borreri*, in its most brilliant and beautiful state,—the "*seminudum*," I am told, of Agardh.

In the year 1852, being on a visit of a few days to the late Dr. Johnston, at Berwick, I found on the shore there three specimens of the rare *Rhodymenia cristata*, one of which was in fruit. This was

in the month of August; and Dr. Johnston subsequently met with other specimens of the same plant later in the season, as he recorded in the minutes of the Proceedings of the Berwickshire Naturalists' Club.

It is perhaps worth notice, that the *Kallymenia reniformis* found in this neighbourhood has uniformly the small, round-leaved, shrubby character of the figure of it in Sowerby's 'English Botany.' The fruit is also large for the size of the plant.

If these trifling notices can be made available for the information of any of your readers, I shall be very glad.

Yours, &c.,

MARGARET GATTY.

ON THE SUPPOSED NEW BRITISH SPECIES OF SKENEAE.

To the Editors of the Annals of Natural History.

Upton Hall, Birkenhead, Feb. 9, 1857.

GENTLEMEN,—I am indebted to the kindness of J. Gwyn Jeffreys, Esq., for permission to send to your Journal the following extract from a letter, the result of an examination kindly undertaken by him of the small *Skenea* found by me at Falmouth,—which I at first considered a new species (a short account of which appeared in your Journal a few months since),—and a careful comparison of it with a specimen taken by himself in the Mediterranean, and also a series of the ordinary form of *Skenea rota*, taken in a living state by me at the Land's End and other parts of Cornwall:—

"The result of a careful comparison of these specimens induces me to retain the opinion I at first formed, that your *Skenea tricarinata* is only a variety of *Skenea rota*. Your species appears to differ from *S. rota* in its somewhat smaller size, in the whorls being flatter and more angular (the latter character being probably attributable to the greater prominence and distinctness of the ridges), and in the transverse ribs being less marked and not so nodulose as in the typical form. My specimens from the Mediterranean belong to this variety. All the specimens have three spiral ridges, one of them encircling the periphery and forming an obtuse keel, another on the upper side, and a third on the lower side in the centre of each whorl. The ridges are nearly equidistant from each other, and their direction is marked by a fulvous band: this character has not, I believe, been noticed by any one except yourself. I, however, give this opinion with some reservation, as I should have preferred to have an opportunity of comparing your specimens with others which I have myself collected from various parts of the British and Irish coasts; this unfortunately I cannot do at present, while I am divorced from my cabinets."

I remain, Gentlemen, your obedient Servant,

W. WEBSTER.

On the Influence of Moisture upon the Direction of Roots.

* By P. DUCHARTRE.

The author, after referring to the experiments of Johnson and Knight, in which seeds placed beneath a mass of moist earth, or under a damp sponge hung up in the air, directed their radicle either horizontally, so as to be applied against the moist body, or even vertically from below upwards, and indicating that the experiments of Duhamel, Dutrochet, &c., the results of which were unfavourable to the idea that moisture has any influence upon the direction of roots, were made in such a way that they do not authorize any conclusion to be drawn from them, proceeds to describe some observations of his own on this subject. These observations were made upon two plants of a *Hortensia* and a shrubby *Veronica* (*V. Lindleyana*), the pots containing which had been placed in a hermetically closed apparatus. Under the influence of a confined atmosphere, saturated with humidity, these plants first of all developed, upon the lower part of their stems, roots several centimeters in length, which extended themselves in the moist air, some horizontally, others in a more or less ascending direction. Numerous roots issued from the moderately moist earth in the pots of the two last-mentioned plants, and rose into the moist air, sometimes obliquely, sometimes directly upwards.—*Comptes Rendus*, 5 January 1857, p. 10.

On the Migration of the Starling. By JAMES HARLEY, Esq., of Leicester.*To the Editors of the Annals of Natural History.*

GENTLEMEN,—I am more than half inclined to believe that the observations made by Col. George Montagu on the migratory habits of that pretty bird, the Starling, are correct, although none of our own more recent out-door naturalists have ventured, in their writings, when engaged on its monograph, to advert to that part of its history. Col. Montagu is the only writer, at least with whose descriptions of its habits I am acquainted, that has made mention of the annual migration of this species.

Towards the close of the summer of last year, the writer, accompanied by a near relative, crossed from Folkestone to Boulogne, quitting Folkestone at 4 P.M. The evening was serene, with a smooth sea, and an unruffled Channel. On our losing sight of the English coast, and reaching the midway of the Straits, while engaged in our remarks on the peculiarities of the different passengers who were strolling about the deck of the vessel, a large flock of Starlings crossed our pathway overhead; we observed them at an altitude of thirty or forty yards. The flock appeared to us to consist of many hundred birds, each little creature pursuing its course in a direct line towards the Kentish coast.

After a lapse of several seconds, another flock appeared in view, fled past us, and, in a hurried manner, and by the same aerial route, made the same course towards the land of the free.

Before night-fall, and as we drew near to the coast of France, a

third and more numerous body of Starlings passed the boat with great dispatch, taking the same path as their congeners had done, which we had the good fortune to recognize so clearly in the early part of the evening.

The incident in the history of the Starling to which reference is made, pretty clearly evinces, at least to my mind, that this species of *Sturnus* is migratory in the autumnal months, performing, as it certainly does, a change of situation at that season of the year, in congregated masses and numerous bands, like some other birds belonging to the fauna of these islands. On this matter most of our own monographers have maintained a marked silence, as if ignorant in that respect, as I have said, of the peculiar wandering habit and manners of Larry Sterne's captive bird.

In this part of the kingdom the Starling abounds, especially in our retired woodlands, whole broods being reared in such places annually; the nest of the creature being placed in holes of decayed timber-trees of our thickly wooded parks, likewise within the holes and crevices of ancient buildings, church towers, and ruins, where protection and safety are afforded it during the period of nidification.

For many years past I have not failed to notice its manners throughout the whole autumn and winter season, and in so doing, have ever been led to mark the invariable increase made by the bird in its numerical diffusion at that period.

It has been with me a settled point, for many years past, that a very considerable migration of the species takes place annually; but hitherto such speculation was mere conjecture on my part. I had no proof whatever, by me, of its actual performance. However, in my passage across the Straits in the month of September last, the fact which I have briefly narrated in my letter, fails not to establish unequivocally the migration of the Starling, but proves, moreover, the adoption of its brumal retreat on these shores.

BRITISH AMPHIPODA.

To the Editors of the Annals of Natural History.

Plymouth, Feb. 16, 1857.

GENTLEMEN,—Having had an opportunity, since the publication of the Synopsis of the British Amphipoda, of comparing the necessary works at the British Museum, I am enabled to make the following corrections and addenda:—

After *O. littorea* read (Leach).

After *O. Deshayesi* read (Savigny).

Acanthonotus Owenii (mihi) is *A. testudo* of (Montagu).

Theristes (mihi) must yield to *Bathyporeia* (Lindström), and probably the species *B. Guilliansonia* is the *pilosa* of that naturalist.

Leucothoë procera (mihi) is probably *furina* of Savigny; and also the genus *Dyopodes* (mihi) is *Dulichia* of Kröyer; consequently the family *Dyopodidae* will for the future be changed to *Dulichidae*.

I am, Gentlemen, yours obediently,

C. SPENCE BATE.

Descriptions of some New Species of Tanagers.
By PHILIP LUTLEY SCLATER, M.A., F.Z.S. &c.

NEMOSIA GUIRINA.

Nemosia guira, Sclater, P. Z. S. 1855, p. 155.

Flavescenti-olivacea, superciliis longis cum plaga cervicali utrinque conjunctis flavis: gutture et capitis lateribus nigris: dorso postico cinnamomeo, pectore item cinnamomeo sed saturatiore et magis castaneo: abdomine cinerascenti-flavido, crisso flavicante.

Long. tota 5·0, alæ 2·9, caudæ 2·0.

Hab. New Grenada, Bogota; East Peru.

Three specimens of what would at first sight appear to be *N. guira*, in my possession, two of which are from New Grenada and the third from Peru, offer such a marked difference in the length of the wing on comparison with specimens from the eastern coast, that I cannot avoid separating them specifically. They are also distinguishable, as the yellow colour is more developed on the sides of the neck, but does not form a band between the breast and black throat, as in *N. guira*. And in the *N. guirina* the breast has more of a deep chestnut tinge, which extends quite up to the black throat.

NEMOSIA INSIGNIS.

Nigra, brunnescente tincta: speculo alari et corpore subtus albis: interscapulio et dorso inferiore cum gutture et crisso flavis. ♀ brunnescenti-olivacea, alarum et caudæ marginibus flavescentibus: subtus flavida, lateribus obscurioribus.

Long. tota 5·5, alæ 2·9, caudæ 2·1.

Hab. South Brazil.

Obs. Similis *N. flavicollis*, sed crassitie majore, dorso flavo altius ascendente et gutture pullidius flavo, dorso fere concolore, distinguenda.

I possess three specimens of this *Nemosia*, male, female and young male, out of a collection formed, I believe, in the southern part of Brazil. They are certainly larger in all their dimensions than the *N. flavicollis*, besides showing the other differences above noted, and I think can hardly be passed over as merely a local variety of that species.

NEMOSIA AURICOLLIS.

Nemosia flavicollis ex Cayenna, auct.

Saturate nigricanti-brunnea; speculo alari parvo albo: dorso postico, gutture et crisso aureo-flavis, abdomine albido.

Long. tota 4·6, alæ 2·7, caudæ 1·9.

Hab. Cayenne; East Peru, river Ucayali (*Hawswell*).

Mus. Brit., &c.

Obs. *N. flavicollis* simillima, sed colore brunneo, et dorso postico aurescentiore flavo, necnon speculo alari magis celato, distinguenda.—*Proc. Zool. Soc.*, May 13, 1856.

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XXI.—*Description of some Foraminifera from the Coast of Norway.* By W. K. PARKER and T. RUPERT JONES, F.G.S.

[With two Plates.]

Introduction.—The *Rhizopoda* form an important family of the class *Protozoa*. The *Amœba* is typical of the naked Rhizopods; the *Gromia*, of those with a membranous or coriaceous coating; and those having a calcareous shell constitute the group *Foraminifera*. *Thalassicolla* and its allies* form another related group; and the siliceous *Polycystinæ* are also regarded as members of the same family.

The *Foraminifera* present symmetrical shells, of minute size for the most part, of various patterns, and consisting either of a single chamber or of two or more connected chambers. A jelly-like mass, or “sarcode,” occupies the chambers and their connecting passages; and, protruding itself both from the external aperture of the last chamber, and in many cases from the sometimes numerous perforations in the shell-walls, extends itself not only over the surface of the shell, but also into radiating contractile threads or *pseudopodia*, and into gemmule-like masses, which latter become coated over with calcareous matter, and thus form additional segments of the animal†.

* See *Annals*, ser. 2, 1851, vol. viii. p. 433; and *Quart. Journ. Microsc. Science*, vol. iv. p. 72. Much information relative to the *Protozoa* is contained in the two memoirs here referred to.

† Among the more important works on *Foraminifera*, reference may be made to D’Orbigny’s ‘*Foraminifères fossiles du Bassin Tertiaire de Vienne (Autriche)*,’ Schultze’s ‘*Ueber den Organismus der Polythalamien*,’ 1854; Carpenter’s ‘*Researches on the Foraminifera*,’ *Phil. Trans.* 1856 (two memoirs). In the ‘*Annals*’ for October 1853 is a short notice and some figures of a few *Foraminifera* from the Chalk. For numerous illustrations of well-preserved fossil *Foraminifera*, reference may be made to several memoirs by Rous and others in Haidinger’s *Abhandl.*, the *Vienna Transact.*, and the *Journal of the Berlin Geological Society*.

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The shell itself may be hyaline and tubuliferous, or opaque and homogeneous, or arenaceous, *i. e.* made up of siliceous or other particles cemented with shell-material.

Before proceeding with the description of the Foraminifera from Norway, we think it advisable to offer a few succinct remarks upon the characters of this group of shelled Rhizopods; referring the reader to Dr. Carpenter's recent memoirs for a fuller consideration of the subject.

To arrive at a clear idea of the specific relations of the Foraminifera, we must study these creatures in large numbers; such as well-arranged and extensive collections of specimens from various seas and harbours, and from numerous fossil deposits, can alone supply. (See Carpenter, *loc. cit.* § 74.)

It must be understood that, although among the lowest orders of plants and animals—such as *Conferæ* and *Diatomaceæ*, *Infusoria* and *Rhizopoda*,—the immense numbers of mere varieties, passing by indistinguishable gradations of shape one into another, have been by some authors enumerated as so many specific forms, yet there is no real ground for the establishment of *species* on these variations of character, which are for the most part merely such differences among individuals as one finds between the several leaves of a single tree.

Foraminifera, indeed, are to be compared with the other lowest orders of animals and of plants in the study of their specific relations. In these several low forms of creatures we have comparatively few species, but extremely numerous individuals, with an enormous range of variety. In the higher orders of plants and animals the specific forms are more definite, there being a more complex organization, harmonizing with the special habits of each creature; and the individuals of each species are less numerous than is the case in the Protozoans and Protophytes.

These low animals, the *Foraminifera*, having great simplicity of structure, more easily adapt themselves to varying external conditions than the more complex and specialized higher animals (see Carpenter, *loc. cit.* § 76). Hence the greater immunities enjoyed by these Protozoa from the various causes of extinction acting upon the individuals of the higher classes; and the long existence of several special *Foraminifera* through nearly all the geological epochs, appears to be in a great degree a consequence of this adaptability to circumstances, and the resulting tenacity of existence.

As these little shelled Rhizopods live under an immense variety of circumstances as to climate, depth of the sea, and its saltness, different composition of the sea-bed, varieties of bodies to which they adhere, &c., it cannot surprise us that one and the same species should exhibit a great range in variety as to

size, thickness, ornamentation, &c. Mostly cosmopolite, they present species that have individuals both in shallow and in deep seas, in brackish and in salt water, within the Arctic Circle and at the Equator; and consequently one form will be represented by thin-shelled and by thick-shelled individuals, by smooth and rough, by convex and flat, and by infinitely small and comparatively monster specimens.

Further, to enter into details, the individual parts of a Foraminifer may be seen, in different individuals specifically allied, to have very various proportions of size. The primordial chamber may be either extremely small or largely distended,—the smallest or the largest in the whole shell: the succeeding chambers may be short and globular, or elongated and narrow: the exogenous growths of shelly matter may be delicately distributed in lines and points, or coarsely agglomerated, masking a whole surface; they may be nearly absent in one, and forming a serrated or an entire wing or keel in another: the shell may be in one group hyaline or sandy; in another, it may be white and opake, or coloured and gritty: the small shells, indeed, are usually smooth, the larger ones often coarse or sandy.

Not only do the individuals of a species present frequent differences in the relative proportions of their chambers, and in the degrees of thickness of the shell-walls, according to certain recognizable conditions of habitat, &c., but there are also to be found still further departures from a determinate type,—always, however, within certain specific limits; when, for instance, a Nautiloid form takes on a rectilinear growth; or, *vice versâ*, a Stichestegian is partially curved; or when a cycloidal growth is in part replaced by a spiral; or the opposite.

We need not here do more than allude to the interesting branch of research in the relations of these lowly-classed creatures which has reference to the representative forms which they continually exhibit, both amongst themselves and with respect to higher groups of shelled animals. Not only do the varieties of one species exhibit peculiarities of form which are more especially characteristic of other and definite species, but the *Foraminifera* present remarkable mimetic resemblances to the various *Mollusca* and Molluscan groups; thus, for instance, we see the straight and variously-curved *Cephalopoda* (including the fossil forms) markedly imitated by the *Foraminifera*.

With regard to the nomenclature of this widely-diffused group, a certain licence must be allowed in the use of binomial terms for some and not a few forms, which are physiologically varieties, however protean and distant from the specific type, and have no strict title to a separate place in the list of species. Many species, however, present such numerous varieties of form, ranging

between wide limits of size, shape, and ornament, that, for the sake of convenience, these may retain for the present the names that have been proposed for them on the supposition of their specific distinctness; especially as many of the varieties are characteristic of climatal or hydrographical habitat, or of geological range.

The materials for the following descriptions were derived from the dredgings made by Messrs. MacAndrew and Barrett in the North Sea, during the summer of 1855. One portion was received from Mr. Barrett, in small boxes, numbered, and labelled with the depths and localities of the dredgings; another portion was the sandy refuse from a jar in which specimens of Molluscs, &c., had been preserved in spirits,—this we received from Mr. Woodward; and thirdly, Mr. Bowerbank favoured us with a packet of shelly sand obtained when preparing sponges taken in the same dredgings. The latter lots of sand were manipulated and examined together; and no particular depths and localities have been noted for the specimens derived from this source. The sponge-sand was obtained from several localities between Drontheim and the North Cape, at depths varying from 30 to 200 faths.

The series of which the exact localities and depths are known comprises seven lots; these, with their characters and contents, are arranged in the following Table.

	Locality	Depth in fathoms.	Character of Sea-bottom, &c	Generic and Subgeneric forms
1.	East of Rolfs Oe, or Bred Sound, Finmark	30	gravel	Polymorphina, Anomalina, Truncatulina, Biloculina, Quinqueloculina, Placopallina.
2.	Omnocs Oe, Nordland	40	gravel	Anomalina, Truncatulina, Quinqueloculina.
3.	West Fjord, Nordland	60	sand	Dentalina, Rosalina, Truncatulina, Quinqueloculina.
4.	Bodoe, Nordland	70-100	sand	Anomalina, Truncatulina, Biloculina, Quinqueloculina.
5.	Vigten Island (Inner Passage), Drontheim	100	on sponge	Rosalina.
6.	Finmark	150	sand	Truncatulina, Quinqueloculina.
7.	Arctic Circle, Nordland	160	mud	Nodosaria, Dentalina, Cristellaria, Anomalina, Truncatulina, Biloculina.
8.	Various localities between Drontheim and the North Cape ...	30-200	various	Lagena, Entosalenia, Dentalina, Polymorphina, Spirillina, Operculina, Nonionina (5 species), Polystomella, Globigerina, Rosalina, Anomalina, Truncatulina, Cassidulina, Valvulina, Bulimina, Uvigerina, Textularia, Quinqueloculina, Placopallina.

The species described or noticed in the sequel may be tabulated with their genera and subgenera as follow.

		1.	2.	3.	4.	5.	6.	7.	8.
	<i>Foraminifera from the Coast of Norway.</i>	30 faths.	40 faths.	60 faths.	70-100 faths.	100 faths.	150 faths.	160 faths.	50-90 faths.
1.	<i>Lagena levis</i> , Montagu.....								*
2.	<i>Entosalenia globosa</i> , Montagu.....								*
3.	<i>Nodosaria lævigata</i> , D'Orb.....							*	
4.	<i>Dentalina communis</i> , D'Orb.....			*				*	*
5.	<i>Polymorphina communis</i> , D'Orb.....	*							*
6.	<i>Spirillina vivipara</i> , Ehrenh.....							*	
7.	<i>Operculina complanata</i> , Basterot.....								*
8.	<i>Noumenina crassula</i> , Montagu.....								*
9.	— <i>communis</i> , D'Orb.....								*
10.	— <i>bulloides</i> , D'Orb.....								*
11.	— <i>asterisans</i> , Ficht.....								*
12.	— <i>striatopunctata</i> , Ficht.....								*
13.	<i>Polystomella crispa</i> , Linn.....								*
14.	<i>Cristellaria Calcar</i> , Linn.....							*	
15.	<i>Globigerina bulloides</i> , D'Orb.....								*
16.	<i>Rosalina vesicularis</i> , Lamarck.....			*		*			*
17.	<i>Truncatulina lobatula</i> , D'Orb.....	*	*	*	*	*	*	*	*
18.	<i>Anomalina coronata</i> , nov.....	*	*		*			*	*
19.	<i>Cassidulina lævigata</i> , D'Orb.....					100			*
20.	<i>Valvulina triangularis</i> , D'Orb.....								*
21.	<i>Bulimina marginata</i> , D'Orb.....								*
22.	<i>Uvigerina pygmaea</i> , D'Orb.....								*
23.	<i>Textularia Sagittula</i> , DeFrance.....								*
24.	<i>Biloculina rugens</i> , Lamarck.....	*		*				*	*
25.	<i>Quinqueloculina Seminulum</i> , Linn.....	*	*	*	*		*		*
26.	<i>Placopsilina Canariensis</i> , D'Orb.....	*							*

The foregoing general observations on the characters and relations of the *Foraminifera* will be illustrated in several points by details of structure and habit in the following descriptions. We shall not, however, offer a general *résumé* of the relations of the genera and species here described, much less can we attempt to draw up a classification of the *Foraminifera*. Dr. Carpenter truly observes that the subject is still far too incompletely worked out for even the exact determination of the *species* and *genera*.

The following descriptions are offered as supplying materials towards a future classification; they are drawn up sometimes without reference to any already-established generic types, especially in cases where the relations of a species or genus seem to have been more or less misunderstood, or in want of clearer elucidation. To give some tangible form, however, to our observations

on the Norwegian specimens, we append an avowedly imperfect, but perhaps useful, list of genera and subgenera, showing approximately the more evident of the relations which the Foraminifera commonly met with present towards each other.

<i>Hyaline (and sometimes arenaceous)</i>				<i>Homogeneous (and sometimes arenaceous)</i>	
<i>Lagena</i>	<i>Entosalenia</i>	<i>Orbulina</i>	<i>Monotha</i>
...	<i>Spirulina</i>	<i>Cornuspira</i>	<i>lamous.</i>
<i>Nodosaria</i>	<i>Polymorphina</i>	<i>Rotalia</i>	<i>Globigerina</i>	<i>Hauerina</i>	} <i>Polysalenia</i>
<i>Luugulina</i>		<i>Amphistegina</i>	<i>Rosalina</i>	<i>Vertebrulina</i>	
<i>Fronducularia</i>		<i>Heterostegina</i>	<i>Anomalina</i>	<i>Sphaeroidina</i> &	
<i>Dentalina</i>		<i>Nummulina</i>	<i>Truncatulina</i>	<i>Dimorphina</i>	
<i>Vaginulina</i>		<i>Operculina</i>	<i>Cassidulina</i>	<i>Miliola</i> (Bi-	
		<i>Nonionina</i>	<i>Valvulina</i> &	<i>loculina,</i>	
		<i>Polystomella</i>	<i>Clavulina</i>	<i>Triloculina,</i>	
		<i>Cristellaria</i>	<i>Bulimina</i>	<i>Quinquelo-</i>	
		<i>Flabellina</i>	<i>Uvigerina</i>	<i>culina, &c.)</i>	
			<i>Verneulina</i>	<i>Fabularia</i>	
			<i>Textularia</i> &	<i>Amorphina,</i>	}
			<i>Bigenerina</i>	(Parker, MS)	
				<i>Alveolina</i>	
				<i>Orbitolites</i> and	
				<i>Polytrypa</i>	
				<i>Orticulina</i>	
				<i>Peneroplus</i>	
				<i>Placopsilina</i>	

[Note.—The genera and subgenera printed in small type are inserted as important members of the series, but do not occur among the specimens from the Norway coast.]

We have to express our acknowledgements for Prof. Williamson's kindness in giving us his opinion on the relations of the more important of the Norwegian specimens. Our thanks also are due to Prof. Tennant for having lent us his set of D'Orbigny's valuable models, without the free use of which we could not have satisfactorily determined the alliances of several species from the dredgings.

1. *Lagena levis*, Walker and Montagu. Pl. XI. figs. 22 & 23.
Var. *striata**. Pl. XI. fig. 24.
2. *Entosalenia globosa*, Montagu, sp. Pl. XI. figs. 25–29.
Var. *marginata*. Pl. XI. figs. 28 & 29.
Var. *striata*. Pl. XI. fig. 27.
Var. *catenulata*†. Pl. XI. fig. 26.
Var. *squamosa*. Pl. XI. fig. 25.

[See Mr. Williamson's Monograph on the "Recent British Species of the genus *Lagena*," Annals of Nat. Hist. ser. 2. vol. i. pp. 1–20, pl. 1 & 2.]

Figs. 22 to 29 represent a series of forms of minute mono-

* The striated varieties of the flask-shaped *Lagena* supply five species in D'Orbigny's Voyage Amér. Mérid. vol. v. part 5. pl. 5. f. 4–12.

† *Oolina Melo*, D'Orb. *ib.* f. 9.

thalamous Foraminifera selected from the Norway dredgings, and here figured, for the purpose of showing the wide variations of shape and size presented by these shells, and every gradation between which is met with among specimens from this and other sources, including recent and tertiary deposits.

Fig. 22 presents the long-necked, flask-like, typical form of *Lagena**; and figs. 23 & 24 are two of its varieties: in fig. 23, the convexity is less than in fig. 22, the base is elongate, and the neck is rimmed: in fig. 24, the body of the "flask" is still more cylindrical, the neck is shorter, the surface has several parallel ribs, and the base is perforate. This extreme variety of form (fig. 24) is related, by endless intermediate variations (including fig. 23), with the gibbous form, fig. 22. Fig. 27 is a ribbed *Entosalenia*, and is vastly more gibbous than fig. 24, being almost globular; it is numerous and deeply ribbed, and is thickened around the aperture with a frill of four equal obtuse angles. Fig. 26 differs from the last in having its less numerous ribs united by small transverse ridges, and in having its neck less thickened and shorter. In fig. 25 the superficial ornament is formed of hexagonal meshes, as if the transverse and longitudinal ridges had been equalized and combined into a reticulation. These three forms (figs. 25 to 27) are also in every respect linked together by numerous recent and fossil varieties, and gradually pass, by insensible gradations of external character, into the elongate varieties of *Lagena*, such as figs. 22-24.

Figs. 28 and 29 represent the common, somewhat flattened, margined, round and oval varieties of *Entosalenia*†, which, by losing their keels, becoming globose‡, and being provided with an external instead of an internal tube, closely represent the flask-shaped *Lagena* represented by fig. 22. They are very subject to ornamentation of riblets and reticulation (figs. 25-27), and, excepting by means of the characteristic usual internal tube, are scarcely divisible from *Lagena*. Still, however, there is a peculiarity in the setting-on, as it were, of the tubular neck in the externally-tubed individuals referred to, which appears to permanently distinguish *Entosalenia* from *Lagena*. From the very minutely-marked gradation of differences between individuals, even in the same sample of sea-sand (recent or fossil), it is extremely difficult to speak of anything like specific characters among the endless varieties of *Lagena* and *Entosalenia* presented to the observer.

Marine sands from Shetland, Skye, Pegwell Bay, Eastbourne, Australia, Bombay Harbour, &c., also the post-tertiary clay be-

* *Oolina clavata*, D'Orb. For. Foss. Vien. pl. 1. f. 2, 3.

† *O. compressa*, D'Orb. Voy. Amér. Mérid. vol. v. part 5, pl. 5. f. 1, 2.

‡ *O. globosa*, D'Orb. ib. f. 3.

neath the Lincolnshire fens, and the Grignon tertiary beds, have been the chief sources for these observations.

The figured specimens illustrate the chief varieties of these shells, which are tolerably numerous in the Norway dredgings.

In registering the Norwegian forms of these two interesting and variable species, we have taken the trivial term *lævis*, which indicates the first in the series of *Lagena* described by Mr. Williamson, as the most convenient appellation for the typical form; and *globosa* as the best and earliest for *Entosalenia*. The varieties are almost as numerous as the individuals; non-essential characters only occurring as guides for us in the classification of the innumerable forms.

We must refer the reader to Williamson's admirable and careful exposition of the nature and characters of *Lagena* and *Entosalenia*; merely observing that, for reasons above alluded to, we regard the forms here figured as referable to a single species either of the one or of the other genus*.

8. *Nodosaria lævigata*†, D'Orb. Pl. X. figs. 6-9.

Soldani, Testac. et Zoophyt. pl. 101. f. *kk*; pl. 105. f. Q. R; pl. 118. fig. E. (smooth); pl. 96. f. N. O. P. Q. R. S. (striated).

Nodosaria (subgen. *Glandulina*) *lævigata*, D'Orb. Ann. des Sc. Nat. vol. vii. p. 252. no. 1. pl. 10. f. 1-3.

Nodosaria (Gland.) *glans*, D'Orb. *ib.* no. 2: Modèles, no. 51. 3 livr. [finely ribbed variety of *N. lævigata*].

Glandulina lævigata, D'Orb. Foram. Vien. p. 29. pl. 1. f. 4, 5; *G. ovula*, *ib.* f. 6, 7; *G. angulata*, *ib.* f. 8, 9.

Nodosaria humilis, Roemer, Verst. Nordd. Kreid. p. 95. pl. 15. f. 6.

Nodosaria cylindracea, *N. conferta*, *N. oligostegia*, Reuss, Verst. Böhm. Kreid. i. p. 25-29. pl. 13. f. 1, 2, 10, 19, 20.

Glandulina rotundata‡, *G. tenuis*, *G. major*, *G. laguncula*, and *Orthocerina pupoides*, Bornemann, Liasform. Göttingen, p. 31. pl. 2. f. 1-5, p. 35. pl. 3. f. 14, 15.

* As Mr. Williamson truly remarks, Walker was the first to give the name "*Lagena*" to these flask-like Foraminifera.

† In this instance we have taken some trouble to collate the figures and descriptions of numerous varieties of this shell from those works which are at present accessible to us. This is done to indicate the wide extent of variation in this species; and it also shows its great range both in time and space. Many of the named varieties in this list are doubtlessly characteristic of the individuals, and useful to geologists; but we decline the task of pointing out which should be preserved. Nor do we propose to supply similar lists of synonyms for the other species which will here come under notice.

‡ The varieties of *Nodosaria* figured by Bornemann (*op. cit.*) from the Lias of Göttingen, present an instructive series of gradations of form in one species. The smooth forms (above enumerated) have from three or four to six chambers, and vary considerably, both in general size and in the relative proportions of their chambers. Several ribbed forms are also figured

Dentalina brevis, D'Orb. Foram. Foss. Bass. Vienne, p. 48. pl. 2. f. 9, 10.
Glandulina cylindrica, *G. ovalis*, and *G. subrotunda*, Alth, Haidinger's Abhandl. iii. p. 270. pl. 13. f. 30, 31, 32.

Glandulina pygmaea, *G. manifesta*, *G. cylindracea*, *Nodosaria proboscidea*,
Dentalina marginuloides, Reuss, Haid. Abh. iv. p. 22. pl. 2. f. 3-6, 12.

Glandulina discreta, Reuss, Denksch. k. Akad. Wiss. Wien, i. p. 366. pl. 46. f. 3.

Glandulina concinna, Reuss, Zeitschrift Deutsch. Geol. Gesell. vii. p. 263. pl. 8. f. 1.

Glandulina inflata, *G. laevigata*, *G. elongata*, Bornemann, *ib.* p. 320. pl. 12. f. 6-9.

Shell smooth and hyaline; varying from acutely pyriform and spindle-shaped to subcylindrical and pupa-like; usually circular in cross-section, but sometimes slightly oval; formed of about six chambers in a single row, closely fitting and somewhat overlapping each other; chambers usually rapidly increasing in size after the early ones (fig. 6), but sometimes the later chambers retain a nearly uniform width (fig. 9), in which case the sutures are more or less constricted. A slight variation from a straight line in the long axis of the shell is occasionally observable (fig. 9, *Dentalina brevis*, D'Orb.). Aperture small, central, either round or slightly oval and transverse (fig. 7), somewhat projecting, and surrounded by about thirty radiating fissures, more or less distinct.

About thirteen specimens, exhibiting several variations of form, were dredged from a muddy bottom at 160 fathoms, within the Arctic Circle (Finmark).

This *Nodosaria* has been found in the tertiaries of Italy and Austria; it abounds in the London Clay, presenting several of the intermediate forms connecting figs. 6 and 9. It is common also in the Lower Chalk of Kent and Germany; and is one of the most common Foraminifera in the Kimmeridge Clay near Aylesbury, and in the Lias of Göttingen* and of Ilminster†.

Nod. laevigata lives in the Adriatic. We have not yet found this species recent elsewhere than in these Norway dredgings, where it is larger than the fossil specimens above referred to.

The compressed pupa-like variety of this "*Nodosaria*," passing into "*Lingulina*," may be compared with the *Lingulina* of

by Bornemann (*loc. cit.*), which are evidently of the same specific type as the smooth, and present a steady gradation in the setting-on of the riblets, 5, 6, 7, 8, 9, 11, in individual *Nodosariae* which have nothing essentially characteristic in shape, size, or structure, to enhance the trivial value of this ornamentation. In Bornemann's figs. 19 & 21 (pl. 3, *loc. cit.*) there are smooth *Linguline* forms, nearly related, on the one hand, to the above-mentioned *Nodosaria*, and on the other, to the smooth and the ribbed *Fronicularia* figured on the same plate. See also the ribbed *Linguline* form of *N. laevigata* (*N. costata*, D'Orb.), pl. 3. f. 1-5. Foss. Foram. Vien.

* Bornemann, *op. cit.*

† Mr. C. Moore's Collection.

the Chalk, the tertiary *Lingulinæ* of San Domingo, and the recent ones of the Canaries†.

4. *Nodosaria* (*Dentalina*) *communis*, D'Orb. Pl. X. figs. 3, 4, 5.

Nodosaria (subgen. *Dentalina*) *communis*, D'Orb. (Ann. des Sc. Nat. vii p. 254. no. 35.)

Shell hyaline, elongate, tapering, somewhat bent, circular in section, composed of several chambers; sutures more or less constricted; aperture produced, small, round, central or excentric.

Fig. 3 was dredged at 160 fathoms on the Finnmark coast; figs. 4 and 5 represent an individual from 60 fathoms at West Fiord, Nordland.

This form is of frequent occurrence in the Chalk and the Tertiary deposits; and is found also, but usually of a small size, in the recent sea-sands.

The infinite varieties presented by these delicate, tapering, arcuate *Nodosariæ* (or *Dentalinæ*, as they are usually termed) have, as far as authors have been able to figure them, received name upon name; and it will require much research to arrange the varieties under normal specific types.

4*. *Nodosariæ*. Pl. XI. figs. 1, 2.

Nodosaria (*Dentalina*) *communis*, var. fig. 1.

Nodosaria (*Vaginulina* ?) ? fig. 2.

These are fragments (figured upside down) of two stichostegian shells, with oblique, closely-set chambers.

Fig. 1 has its chambers somewhat separated by sunken sutures, and its section transversely is nearly round. It belongs to the same type as *D. communis*.

The other (fig. 2) is not constricted at the junctions of the chambers; it is elliptical in cross-section, and is ornamented with slight, irregular, longitudinal riblets. [The apparent aperture in fig. 2 arises from the first chamber having been broken open.] One other fragmentary specimen occurred, consisting of the base or first few chambers, similar in character to fig. 2, but having a large primordial chamber and a faintly helical arrangement of the two next chambers, before the axis of the shell takes the straight direction; thus approaching the so-called "*Vaginulinæ*" and "*Marginulinæ*" in the mode of growth of the early segments, in the nearly uniform size of the chambers, and their elliptical transverse sectional area.

These nearly straight, obliquely-chambered *Nodosariæ* have numerous representatives, both in the recent and the fossil state.

† Hist. Nat. des îles Canaries, Foram. p. 124. pl. 1. f. 5, 6.

5. *Polymorphina communis*, D'Orb.

Pl. X. figs. 25, 26, 27; Pl. XI. figs. 30-34.

Polymorphina (*Guttulina*) *communis*, D'Orb. Ann. Sc. Nat. vii. p. 266 no. 15. pl. 12. figs. 1-4; Modèles*, no. 62.

Figs. 30 and 31 (Pl. XI.) exhibit an early condition of *Polymorphina*, in which we see an *Entosalenia*, slightly modified, playing the part of the primordial chamber of this form. This Entosalenian condition of *Polymorphina* is nearly always apparent in specimens sufficiently small or unadvanced to leave the early chambers translucent and open to examination. The exceptions to this are chiefly individuals in which the aperture is lengthened outwards and produced into an irregular, ramified, or stag-horn system of tubes; and here, as in those *Entosalenæ* in which the aperture is externally tubular, the inner tube becomes obsolete. As they advance in growth, the individual *Polymorphinæ* are invested with additional chambers after a type peculiar to themselves, but in a very irregular manner as regards the capacity and shape of the chambers. The typical arrangement of the chambers is best shown in fig. 25. Pl. X. (*P. ovata*, D'Orb. Vien. Foram. pl. 13. fig. 1), in which they are seen to be set-on angularly and alternately (not quite equally on the two flatter surfaces of the shell), pointing backwards and outwards at an acute angle with the axis of the shell, the later chambers considerably overlapping the earlier ones: in this case they compose a compressed ovate shell; but other and innumerable varieties in the form and relative size of the chambers result, on the one hand, in the production of short, globular forms, like fig. 32. Pl. XI. (*Polymorphina gibba*, D'Orb.), and, on the other, of narrow, elongate shells, like fig. 33 (*Termiculum lacteum*, Montagu; *Arethusa lactea*, Fleming; *P. compressa*, D'Orb.). The intermediate forms so gradually pass one into the other, scarcely two individuals being identically alike, that it is impossible to regard the extreme forms here indicated (as well as many others, both smooth and ornamented, figured by authors under the names of *Polymorphina*, *Guttulina*, and *Globulina*) as really belonging to more than one specific type.

The "stag-horn" condition of the aperture (or, rather, the permanent calcareous tubing of the chief pseudopodia) occurs very frequently†; it has supplied some authors with materials

* By comparing the models, nos. 23, 29, 30, 61, 62, and 63, a good idea may be formed of the variations in the development of the chambers in this species. See also plates 12, 13, and 14 of D'Orbigny's *Foram. Foss. Vienne*.

† Soldani, *Testac. et Zoophyt.* pl. 109, 110, 111.

for new names, and is sometimes even distinguished as a generic character*.

Fig. 84. Pl. XI. represents a loose specimen of the cervicorn tube. Fig. 25. Pl. X. shows the *Polymorphina* from which this branched calcareous appendage was broken. It is to be remarked that the terminal and some of the preceding chambers opened laterally into the overlapping base of the tube by more than one aperture, whilst the chief aperture has become plugged up (excepting perhaps its radiating slits) with calcareous matter, as is not uncommonly the case with adult specimens of other species. (See also fig. 5. Pl. X.)

Polymorphina is for the most part smooth externally, but not unfrequently scabrous or roughish, tuberculate or aciculate, and occasionally bears fine, parallel, shortish riblets (Australia). The superficial aciculæ or points appear sometimes to be minute exerted tubules. None of these exogenous characters can be regarded as of specific value, and they may or may not be present on any variety of form.

This shell occasionally loses its usual translucency or hyaline character, and becomes more or less opaque; but we have never recognized it in a sandy condition†. The common forms vary extremely in size.

We have found *Polymorphina* represented by its chief varieties in the Chalk-marl, and more rarely in the Chalk. It is extremely plentiful in very many of the Tertiary deposits (Grignon, Tours, Bordeaux, Palermo, &c.), also in the post-tertiary clays of Lincolnshire, and in the recent sea-sand from every coast.

The Norway specimens are undistinguishable from numerous individuals from the European and other coasts, and even from Southern Australia.

6. *Spirillina vivipara*, Ehrenberg. Pl. XI. fig. 46.

Spirillina vivipara, Ehrenb. Berlin Trans. 1841, pl. 3. f. 41; *ib.* 1847, pl. 2. f. 82?

Cornuspira perforata, Schultze, Organ. Polyth. p. 41. pl. 2. f. 22.

Shell flat, spiral, like a minute *Planorbis*; not presenting any internal subdivisions, but being monothalamous. The little, elegant, discoidal shell here figured is hyaline, and perforated with rather large pseudopodian passages‡.

There are at least two other discospiral monothalamous For-

* Hence "*Anlostomella*" of Alth, Haid. Abhandl. iii. p. 263. pl. 13. fig. 17.

† Schultze's so-called *Polymorphina silicea* (Ueber den Organ. Polyth. pl. 6. fig. 10) appears not to belong to the *Polymorphinae*.

‡ See Williamson "on some Mud from the Levant," &c., Mem. Manch. Phil. Soc. viii. p. 45. pl. 2. f. 34.

minifera met with in recent sea-sands. One of these, though composed of a clear substance, has no apparent surface-foramina, but only ornamental depressions*; the other is opaque in its homogeneous, non-arenaceous substance, and is probably related to the *Miliola*. Schultze has figured both the perforated hyaline form† (*Spirillina*, Ehrenb.) and the opaque shell‡. He places both in his new genus *Cornuspira*, which can only refer to the latter §.

There are other more or less nearly allied forms, though probably distinct, both discoidal and irregular in the arrangement of their whorls; and some also not truly monothalamous, but beginning at least with one, two, or more well-defined chambers.

The *Spirillina*, *Cornuspira*, and their allies are excessively common in the present seas and in a fossil state, and are usually minute. They are frequent in the Tertiaries (for instance, Grignon, Tours, Bordeaux, London Clay); also in the Chalk, Lias, and Magnesian Limestone||.

7. *Operculina complanata*, Basterot, sp. Pl. XI. figs. 3, 4.

Lenticulites complanata, Basterot, Mém. Géol. Bass. Bordeaux, p. 18.

Operculina complanata, D'Orb. Ann. des Sci. Nat. vii. p. 281. no. 1. pl. 14. f. 7-10

Planulina Ariminensis, D'Orb. ib. p. 280. pl. 14. f. 1-3, and Modèles, no. 49.

The shell here figured is discoidal, flattened, and somewhat square at the edges; spire exposed; chambers about nineteen, in three whorls, slightly overlapping, subquadrate in side-view; septa and edges thickened and elevated; the outer margins of the chambers melting into the marginal border of the shell; the inner margins irregularly thickened, and giving rise to coarse granulations. Shell smooth, shining, hyaline, finely perforate; surface sometimes granulated about the central portion of each surface, and along the edges of the septa and borders of the chambers.

This is an exact miniature of some of the younger specimens of the large *Operculina* which we have from New Zealand¶ and from the Philippines**. It also closely resembles the fossil *Operculina* of the Tertiary deposits, being sometimes granulated

* Also fossil at Bordeaux.

† Schultze, Organ. Polyth. pl. 2. f. 22. ‡ Schultze, op. cit. pl. 2. f. 21.

§ Some fossil forms of these planodiscoid Foraminifera have been described and figured as *Operculina* by Reuss and Cjizek in Haidinger's Abhandlungen and elsewhere (such as *O. cretacea*, *O. angigyra*, *O. involvens*, *O. punctata*, *O. striata*, *O. plicata*).

|| See Mr. T. R. Jones's observations on *Spirillina* in King's "Monograph of the Permian Fossils," Palæont. Soc. 1850, p. 18, and in Journ. Geol. Soc. Dublin, vol. vii. part 2. p. 73.

¶ Through the kindness of Mr. Woodward.

** Communicated by Dr. Carpenter.

like *O. granulosa*, sometimes strongly ribbed like *O. canalifera*, and sometimes approaching the smoothness of *O. ammonica* and *O. complanata**; there being indeed apparently no essential specific difference between our minute specimens, the broad recent forms of the Philippines, &c., and the large fossil varieties above mentioned from France, Italy, Varna, and India.

The little *Operculina* under notice occurs abundantly in some localities of the North British coasts (Shetland, Skye, &c.). It is one of the most common forms in the Norway dredgings.

Planulina Ariminensis, D'Orb., is evidently referable to this species, the model No. 49 exactly representing our specimens. Some slight differences, however, may be recognized between D'Orbigny's figures and both his model and our shells, especially in the aperture, which is rather eccentric in his figure.

8. *Nonionina crassula*, Montagu, sp. Pl. XI. figs. 5, 6.

Nautilus, Walker†, Test. Min. pl. 3. f. 69 & 70.

Nautilus umbilicatus and *N. crassulus*, Montagu, Test. Brit. vol. i. p. 190;

iii. p. 78. pl. 18. f. 1, 2, and perhaps *N. depressulus*, ib. f. 9.

Nautilus incrassatus, Ficht. & Moll, p. 38. pl. 4. fig. a, b, c.

Nonionina incrassata, D'Orb. Ann. des Sc. Nat. vii. p. 293. no. 6.

Nonionina crassula, D'Orb. ib. p. 294. no. 7.

Shell hyaline, discoidal, nautiloid, somewhat depressed, edge rounded; chambers from about eight to sixteen in the outer whorl, triangular in side-view and faintly curved, more or less overlapping the upper and lower surfaces of the former whorls; septa somewhat excavated, especially between the later chambers; umbilicus deep, but sometimes filled up. Aperture varying from

* The beautiful Foraminifer from Malta figured and noticed in the *Annals Nat. Hist.* 2 ser. vol. xv. p. 275. pl. 7. f. 4, as "*Lenticulites complanatus*," is the *Heterostegina depressa*, D'Orb.

† Mr. Walker's figures, like many of the old illustrations of the Foraminifera, are of little aid in the recognition of specific forms. Still, as monuments of the labours of earlier naturalists, they necessarily command respect; and, whenever possible, they are regarded as points of reference for known species. Col. Montagu refigured the Sandwich specimens, and added others (chiefly from drawings supplied by Mr. Boys). Walker's figures and descriptions would certainly be of very little value to us without Montagu's subsequent remarks and illustrations. But even in these later and far superior engravings, much is wanting in the definition of important characters in these minute shells. Mr. Walker should not be quoted as the authority for the specific appellations chosen by Montagu for the Sandwich and other Foraminifera, certainly first figured and diagnosed by Walker, but left unnamed by him in accordance with his avowed intention of not giving his new specimens trivial (Linnæan) names.

We take this opportunity of stating that some of the Foraminifera collected by Boys and Walker at Sandwich, Sheppey, &c., and figured by Walker and Montagu, are undoubtedly fossil specimens washed from the cliffs: particularly figs. 66 & 73, Walker; and pl. 14. figs. 4, 5, & pl. 19. figs. 1, 2, 3, 5, Montagu.

a small arch-shaped notch to a transverse slit across the base of the chamber, where it touches the former whorl.

Common in the Norway dredgings; also at Skye and Shetland, and elsewhere on the British coasts.

Nonionina Soldanii, D'Orb., and several other varieties closely resemble the above; indeed it is merely the presence of non-essential characters, such as the filling-up of the umbilicus, and the varying proportions of size and shape, that divide many of the *Nonioninae* of authors.

9. *Nonionina communis*, D'Orb. Pl. XI. figs. 7 & 8.

Nonionina communis, D'Orb. Ann. des Sc. Nat. vii. p. 294. no. 20; For. Foss. Bass. Vienn. p. 106. pl. 5. f. 7, 8.

Shell hyaline, subovate, nautiloid, spire much hidden by the overlapping of the outer whorl; chambers long-triangular on side-view, rapidly increasing in size, but preserving the same relative shape. Aperture a transverse semilunar slit at the base of the chamber.

This *Nonionina* is not unfrequent at Norway; and is common in the recent seas both of warm and of temperate climates, and also in very many of the Tertiary deposits, especially at Grignon, Bordeaux, Palermo, and Turin.

10. *Nonionina bulloides*, D'Orb. Pl. XI. figs. 9 & 10.

Nonionina bulloides, D'Orb. Ann. des Sc. Nat. vii. p. 293. no. 2; For. Foss. Bass. Vienn. p. 107. pl. 5. f. 9, 10.

Shell hyaline, subglobular; chambers much overlapping, so that only five or six are apparent externally. Aperture a semicircular slit, variable in length, across the base of the chamber.

Occurs in the Upper Tertiaries of Palermo, Italy, and Austria: it is rare in the Norway dredgings.

11. *Nonionina asterisans*, Ficht. & Moll, sp. Pl. XI. figs. 20, 21.

Nautilus asterisans, F. & M. Test. Microsc. p. 37. pl. 3. figs. e, f, g.

Florillus stellatus, Montfort, Conch. p. 134.

Placentula asterisans, Lam. & Blainv.

Pubolulus asterisans, Lam. Enc. Méth. pl. 466. f. 10.

Nonionina asterisans, D'Orb. Ann. des Sc. Nat. vii. p. 294. no. 22.

Shell thinner than that of *N. crassula*, but of denser and more hyaline tissue; discoidal, rounded at the edge; chambers more or less triangular on side-view, rather gibbous, overlapping the older whorl. The aperture is a very narrow curved slit at the base of the chamber. Umbilicus of each surface occupied by a star-shape growth of shelly matter, partially filling up or overlapping the triangular interstices between the umbilical extremities of the chambers. This radiating mass originates in the

growth of calcareous matter from the free edges of the umbilical portion of each chamber, which do not here quite touch each other at their contact with the older whorls; therein differing from the habit of other *Nonioninae*. Occasionally this overgrowth extends further up between the chambers (*N. stellifera* and *N. limba*, D'Orb.), especially in the larger individuals, nearly filling the sunken sutures throughout; and the central mass is often roughened and granular.

In some specimens obtained at Pegwell Bay and Eastbourne, this exogenous growth is traceable from a simple fringe on the free edges above mentioned, to an overlapping, penthouse-like, narrow plate, similar to what is seen on one surface in some asterigerine *Rosalinae*.

This form is not common in the Norway dredgings. It approaches *N. crassula* in its general shape, but the umbilical slits between the chambers and the accompanying astral overgrowth give it characteristic peculiarities. These *Nonioninae*, having their chambers thus partially disconnected, form a link with others, having minute pittings along the septa, towards constituting passage-forms into *Polystomella**.

The asterigerine *Nonioninae* occur in the Mediterranean and the Atlantic (Canaries), and are fossil at Grignon, Bordeaux, and elsewhere.

12. *Nonionina striato-punctata*, Ficht. & Moll, sp.

Nautilus striatopunctatus, F. & M. Test. Microsc. p. 61. pl. 9. fig. a-c.
Nonionina striatopunctata, D'Orb. Ann. des Sc. Nat. vii. p. 294. no. 21.

This interesting form with a pitted condition of the septa (referred to above) occurs in the Red Sea (Fichtel and Moll), and is common in the West Indies. We have found it also in the Norway dredgings, but it was inadvertently omitted in the drawings.

13. *Polystomella crispa*, Linn. sp. Pl. XI fig. 19.

Nautilus crispus, Linn. Syst. Nat. 12 ed. p. 1162.
Polystomella crispa, D'Orb. Ann. des Sc. Nat. vii. p. 283. no. 1; Williamson, Trans. Microsc. Soc. vol. ii. p. 159. pl. 28; Schultze, Organ. Polyth. p. 62. pl. 4, &c.

This well-known shell is not common in the Norway dredgings. It is here represented by a small obtusely-edged and somewhat gibbous form, which has not, however, much thickening at the umbilicus of either surface.

The *P. crispa* is a very protean Rhizopod, yielding numerous varieties named by authors. Sometimes it is thick, and bears

* *Polystomella* is also frequently *Nonionine* in the character of its aperture.

large convex umbilici; and sometimes thin, and either margined with a sharp jagged edge and prickles, or unkeeled and rounded at the edge. The fenestration of the surface appears to be a better specific guide than the shape, size, or spinosity of the shell, or even than its comparative solidity or tenuity. The habitat of individuals, according to depth of water and its estuarine or marine conditions, is well indicated by the relative convexity, strength, and coarseness of their shells. The estuarine variety is generally extremely thin-walled, round-edged, and keelless.

14. *Cristellaria Calcar*, Linn. sp. Pl. X. figs. 10-12, and figs. 1 & 2 (var.).

*Nautilus Calcar**, Linn. Syst. Nat. 12 ed. p. 1162; Gmel. p. 3370.

Nautilus Calcar, varr. α , β , γ , δ , ϵ , ζ , η , θ , ι , κ , λ , μ , Fichtel & Moll, Testacea Microscopica, &c., pp. 69, &c. pl. 11, 12, 13.

Nautilus papillosus, Fichtel & Moll, *ib.* pl. 14. figs. a , b , c .

Robulus cultratus, Montfort, Conchyl. p. 214.

Robulina cultrata†, D'Orb. Ann. Sc. N. vii. p. 287, no. 1 (*Ficht.* varr. β , ζ , η , λ).

Robulina Calcar, D'Orb. Ann. Sc. N. vii. p. 289, no. 12 (*Ficht.* varr. γ , δ , ι).

Robulina costata, D'Orb. Ann. Sc. N. vii. p. 289, no. 13 (*Ficht.* var. ϵ).

Robulina aculeata, D'Orb. Ann. Sc. N. vii. p. 289, no. 14 (*Ficht.* varr. α , θ , κ ?, μ).

Robulina cultrata, D'Orb. For. Foss. Bassa. Vienn. p. 96, pl. 4. f. 10-13.

Lenticulites rotulata, Lamarck, Annal. Mus. v. p. 188, pl. 62. f. 11.

Nummulina rotulata, D'Orb. *loc. cit.* p. 296, no. 8.

Cristellaria rotulata†, D'Orb. Mém. Soc. Géol. Fr. iv. p. 26, pl. 2. f. 15-18.

Shell hyaline, lens-shaped, spiral, involute, nautiloid; chambers slowly increasing in size, varying from about four to ten in the outer whorl, subtriangular in side-view, their inner or umbilical angular portions overlapping the two surfaces of the former whorl; sutures sometimes slightly sunken, sometimes marked by variable linear costæ, either partial, entire, or granular, and

* Linnæus included, and not without reason, the compressed form of *Cristellaria* (Leder Muller, Micr. pl. 8. fig. *d*), now known as *C. Cassis*, under this appellation. *C. Cassis* is not specifically separable from the thicker and more regularly circular *C. Calcar*; but, for the sake of a useful, though artificial, distinction, we here refer to the synonyms of *C. Calcar* (proper) only.

† To the numerous synonyms recognized by D'Orbigny for this species, and enumerated in the "Tableau des Céphalopodes" here quoted, must be added many more from his subsequent list of "species" both of "*Robulina*" and "*Cristellaria*." Very numerous varieties of this shell have been figured and named by authors; for example, the series of *Robulina* and *Cristellaria* in the Zeitschrift deutsch. geol. Gesell. vol. iii. pl. 4, and vol. vii. pl. 13-15; and nearly all the *Robulina*, and several of the *Cristellaria*, in the Foram. Foss. Bassa. Vienn. (pl. 4. f. 1-7, 10-27; pl. 5. f. 1-4).

‡ See D'Orb. *loc. cit.*, and Morris's Catal. Brit. Foss. 2nd edit. p. 33, for further synonyms.

frequently uniting at the umbilicus to form a central disc or group of granules. External edge of the chambers frequently bordered by a keel of exceedingly variable character. Surface of the chambers usually smooth, occasionally granulated.

The specimens here figured are smooth and subcarinate, but the condition of their keel is very inconstant; they are prominent at the umbilici, but have no thickened umbilical discs; nor are the septa thickened or raised, though (as usual) visible externally.

Aperture at the upper angle of the chamber, somewhat produced, and variable; sometimes presenting a round hole, surrounded by numerous slight fissures (as in fig. 1); sometimes the round aperture is slit on the lower side, and becomes ovato-triangular, or even roughly spade-shaped, as in fig. 12.

This variability of the form of the aperture, which is also observable in many of the individuals figured by authors, and among the *Cristellaria* of the London Clay and other deposits, destroys the presumed generic, or even specific, value of "*Robulina*."

The very beautiful series of figures in Fichtel and Moll's *Testacea microscopica aliæque minuta*, &c. (1803) present well-marked individuals of the chief varieties of this delicate and symmetrical shell. Numerous conditions of surface are here apparent: polished and granulate; smooth and costate; smooth-ribbed and granular-ribbed; keeled, partially keeled, and keel-less; serrate-keeled, tooth-keeled, and merely spined without a keel,—these are the variable and interchanged characters, the several groupings of which in individuals these authors recognized in their varieties α to μ ; and by which D'Orbigny endeavoured to arrange these varieties into specific groups. Well might the former despair of finding a specific character distinctive of these varieties*; and, although some of D'Orbigny's binomial terms are not without an incidental value, yet, as far as the specific relations of this shell are concerned, we prefer to follow Fichtel and Moll in reverting to Linnæus's decision, who, seizing the most characteristic variety†, invested it with the

* "*Forma hujus speciei ita comparata est ejusque varietates tam multiplices, ut fere impossibile videatur characterem specificum erui posse, quo hæc species a reliquis congeneribus distingueretur et tamen nulla varietas excluderetur. Ad evitandam omnem, quæ exinde exoriri posset, ambiguitatem et confusionem, optimum nobis visum est, ex multifariis varietatibus præcipuas eligi, earumque unam, secundum quam Linnæus sine dubio nomen suum composuerit, quoad omnes proprietates primum describi, atque reliquas solummodo quatenus afferri, quatenus quolibet a ceteris discedat.*"—*Op. cit.* pp. 69 & 70.

† The acceptance of the tooth-keeled and rowel-like (or the most developed) form as the most characteristic variety, appears to us to be quite correct.

appropriate trivial name; and in regarding the other forms as varieties, often worthy of some distinctive mark, number, or even name.

Figs. 1 and 2 (Pl. X.) represent an elongate, somewhat arched, flattened, keeled, sheath-like shell, with a produced, marginal, round aperture. It is similar in all essential characters to the lenticular *Cristellaria* above described, fig. 10, excepting in the almost total absence of spirality. It is indeed the non-coiled form of *Cristellaria rotulata*. Such a condition is of very frequent occurrence wherever *Cristellaria* is a common shell*. The gradations of form from the closed-up nautiloid shell to the elongate form ("Marginulina" of authors) are very numerous in the London Clay and other Tertiaries†, in the Chalk, Gault, Kimmeridge-clay, and the Lias‡.

In fig. 1 we may observe an instance of a small intercalary chamber,—the result of injury or of a temporary stunted growth.

The Norway dredgings afforded about twenty specimens of the rotulate *Cristellaria*, and two of the marginuliform specimens (all from Nordland, at 160 fathoms).

This *Cristellaria* is common in the recent state (but of very small size) at Margate; and still smaller at Skye§ and Shetland||, and in Australia. This shell, of equal size with the Norway specimens, but rather flatter in shape, is found fossil in San Domingo; nor does it appear possible to separate it (except as a conveniently distinguished variety) from the large and keeled forms (*Cristellaria Cassis*) common in the pliocene beds of Spain (Malaga), Italy, and Austria.

The rotulate *Cristellaria* is common in the Tertiary deposits, the Chalk, Chalk-marl, Gault, and in some of the Oolites.

15. *Globigerina bulloides*, D'Orb. Pl. XI. figs. 11, 12.

Globigerina bulloides, D'Orb. Ann. des Sc. Nat. vii. p. 277. no. 1; Modèles, no. 17 & no. 76; Foss. For. Bass. Vienn. p. 163. pl. 9. f. 4-6.

Globigerina cretacea, D'Orb. Mém. Soc. Géol. Fr. iv. p. 34. pl. 3. f. 12-14.

* An analogous companionship of the rotulate *Cristellaria* and a marginuliform variety is to be found in Prof. Bailey's "Microscopical Examination of Soundings made by the U. S. Coast-survey off the Atlantic Coast of the U. S.," Smithsonian Contributions to Knowledge, vol. ii. 1851. In this case the two forms (*Robulina D'Orbignii* and *Marginulina Bacheii*, Bailey) accompany each other in the soundings of from 51 to 90 fathoms.

† See Foss. Foram. Bass. Vienn. pl. 3: compare f. 9-15 and f. 24, 26, 28, 37; also f. 22, 34, and 36.

‡ Bornemann, Liasformat. Göttingen, pl. 4.

§ We have to thank Prof. Williamson for numerous interesting Foraminifera from this locality.

|| Both Prof. Williamson and Mr. Bowerbank have kindly favoured us with specimens and sea-sand from Shetland.

Globigerina concinna, *G. diplostoma*, and *G. triloba*, Reuss, Vienna Trans. i. p. 373. pl. 46. f. 8-11.

This well-known and extremely common species, essentially a deep-sea shell, and of a fine rose-colour when fresh (*G. rubra*, D'Orb.), is extremely variable in size and shape, though easily recognizable. It affords several species to authors.

It is excessively abundant in the Chalk (*G. cretacea*, D'Orb.), rarer in the Gault, and abundant in nearly all Tertiary beds of deep-sea origin, especially muddy deposits. It is the common form in the deep-sea dredgings of the North Atlantic (Submarine Telegraph); and we have it from Crete (at 360 fathoms), and from the coasts of North Britain. It appears to be rare in dredgings from shallow water and in sponge-sands.

16. *Rosalina vesicularis*, Lamarck, sp. Pl. X. figs. 22-24;
Pl. XI. figs. 13, 14.

Ammonia, Soldani, Sagg. Orittos. p. 104. pl. 3. f. 25.

Discorbites vesicularis, Lamarck, Annal. Muséum, vol. v. p. 183, vol. viii. pl. 62. f. 7; Defrance, Dict. Sc. Nat. pl. f. 2.

Rotalia (*Discorbis*) *Gervillii*, D'Orb. Ann. Sc. Nat. vii. p. 274. no. 36; Modèles, no. 72.

Shell hyaline and finely perforate, discoidal, plano-convex, exhibiting its spire more on the raised than on the flat surface; chambers overlapping to the umbilicus on the latter surface; on the former, the chambers of the last whorl extending only half-way over the earlier whorl; chambers curved on side-view; varying from triangular to subquadrate, on one surface, with the later ones lobular; on the other, long subtriangular, with an angular bend in the middle; 16 apparent on the convex, and 11 on the flat surface. Aperture a slit at the base and terminal edge of the chamber, combined with open slit-like spaces between the lengthened inner corners of the chambers on the flat surface. These converging angles of the chambers are bordered, along the posterior edge of each, with irregular growths of shell-matter, varying from slight valvular laminae to coarse granular accumulations; in the latter case this overgrowth, extending around and over the umbilicus, connects the umbilical processes of the chambers and their little penthouse laminae into a roughened mass perforated by irregular passages.

One specimen of this fine large species of *Rosalina* with an asterigerine umbilicus (fig. 24) was obtained in sand at West Fiord (Nordland) from 60 fathoms depth; and eight specimens occurred on sponge from 100 fathoms at Vigten Island, Inner Passage (Drontheim).

Figs. 13 and 14, Pl. XI., are young forms of this species, and are not uncommon in the miscellaneous sand of the dredgings.

We have met with a small *Rosalina* similar to the above in the Calcaire grossier of Grignon, where Lamarck's *Discorbites vesicularis* was also procured. D'Orbigny quotes it as fossil at Valognes.

D'Orbigny's model, No. 72, is a close representation of our large specimens, excepting in the form of the umbilical astral overgrowth, which in the former case presents neat elongate-ovate lobules, instead of the less regularly defined and granulated mass occurring in the old shells from Norway.

17. *Truncatulina lobatula**, A. D'Orb. Pl. X. figs. 17-21.

Nautilus, Walker, Test. Minut. pl. 3. f. 57.

Serpula lobata, Montagu, Test. Brit. p. 515, and Suppl. p. 160.

Serpula nautiloides, Schrötter, N. Litterat. 3. p. 283. pl. 3. f. 22, 23; Gmel Syst. Nat. p. 3739.

Lobatula vulgaris, Fleming, Brit. Anim. p. 232.

Truncatulina tuberculata, Sold. sp., D'Orb. Ann. Sc. Nat. vii. p. 279. no. 1; Modèles, no. 37.

Truncatulina lobata, D'Orb. Hist. Nat. Canaries, Foram. p. 134.

Truncatulina lobatula, D'Orb. For. Foss. Bass. Vienn. p. 168. pl. 9. f. 18-23.

Shell discoidal, plano-convex, spire unequally shown on the two surfaces, the chambers (in the typical form) overlapping on one side and not on the other. Chambers broadly triangular on the convex surface, subquadrate on the other, not increasing rapidly in size, and subject to much variation in their proportions. Aperture a slit at the base of the chamber, not reaching along the overlapping portion of the chamber, but most open towards the truncate or flattened face of the shell, and sometimes continuous with the persistent apertures of some of the preceding chambers along this face. Shell thickish, reddish or livid when fresh, usually white in dead specimens, semi-diaphanous, and punctured with large pseudopodian apertures.

The specimens here figured are large individuals, preserving greater regularity in the arrangement of their chambers than is usually met with in specimens of their size; yet even here the outline of the shells is much affected by the varying development of the segments of the animals.

Truncatulina lobatula supplies many named varieties in memoirs both on fossil and recent Foraminifera.

In shallow and rough water this species soon takes on an irregularity of growth; the whorls first becoming unsymmetrical by intercalary and misplaced or overlapping chambers, and then

* This form appears to be entitled to Schrötter's unfit appellation "nautiloides," by the right of priority. We here propose, however, to accept A. D'Orbigny's adaptation of Turton's name "lobatula," used by Maton and Racket (Linn. Trans. vol. viii. p. 117), and well known to collectors.

losing themselves in a wide-spread flat form, consisting of numerous chambers, sometimes with somewhat of a cyclical mode of growth (*Planorbulina**), at others with a very variable arrangement of the chambers† (*T. variabilis*, D'Orb.). In both of these flat forms (*Truncatulina* and *Planorbulina*) the shell is affixed to fronds of sea-weeds and to shells.

In another condition of growth also (*Acervulina*‡, including perhaps *Rosalina globularis*, D'Orb.) it enwraps small stalks of sea-weeds and polyparians.

This is a world-wide species: it is common in the Tertiary deposits; and is found also in the Chalk. It is numerous in all the Norway dredgings.

18. *Anomalina* § *coronata*, nov. sp. Pl. X. figs. 15, 16.

This shell has the general aspect and bearing of the common *Truncatulina*; but it is not depressed, and affects a bilateral symmetry, the two surfaces being often nearly equal. The umbilici are deeply and broadly sunken; the convexity of the chambers forming an almost ridge-like corona on each face of the shell. The aperture is a transverse chink at the base of the chamber (as in *Nonionina*), being an extension of the slit-like aperture of *Truncatulina lobatula* in accordance with the increased width of the chamber on the side which is undeveloped in the latter flattened form.

In the texture of shell, sunken umbilici, and almost symmetrically nautiloid form, this shell is an *Anomalina*, D'Orb.

The specimen figured (figs. 15, 16) is the most symmetrical of the individuals collected; others approach more nearly to the common *Truncatulina*.

This is a very common form in the Norway dredgings; being comparatively numerous at 30, 40, 70–100, and 160 fathoms. Elsewhere we have only found it in two deposits of the French Tertiaries; and there it appears to be of great rarity, though even larger in size than the Norway specimens.

* *Serpula conoconerata*, Montagu; *Lobatula conoconerata*, Fleming; *Planorbulina nitida* and *P. Mediterraneensis*, D'Orb. Ann. Sc. N. vii. p. 280.

† Soldani, Testac. et Zooph. pl. 75–93.

‡ *Acervulina*, a genus instituted by Schultze (Organ. Polyth. &c.), but to be taken in a larger sense than intended by that author, appears to form a very typical group of species which, after developing a certain number of chambers as *Rosalina*, become more or less cyclical in their growth; each chamber developing new segments from one, two, or three funnel-shaped apertures on its periphery. *Truncatulina* may be said to be an *Acervulina* arrested at its *Rosalina* stage of growth.

§ For the sake of convenience we retain the subgeneric names *Truncatulina* and *Anomalina* instead of the more comprehensive term *Acervulina*.

19. *Cassidulina lævigata*, D'Orb. Pl. XI. figs. 17, 18.

Cassidulina lævigata, D'Orb. Ann. Sc. Nat. vii. p. 282. pl. 15. f. 5 & 6.

Shell suborbicular, smooth, hyaline; the Norway specimens are rather flattened and have the edge of the shell sharp. Chambers more or less oblong, alternating in a double series along an axial line, and the whole arranged irregularly on a spiral plan, so that the earlier-formed chambers are at intervals trespassing upon and partially overcrossed by succeeding chambers formed at a very different angle from that of their predecessors; hence some of the chambers appear as if they were small and intercalated. In the Norway specimens about 8 to 11 chambers are apparent. Aperture a narrow curved slit towards the spire and parallel with the lower edge of the chamber, the terminal face of which is flat and oblique. The aperture has a partial projecting valve-like lip.

This *Cassidulina* is excessively abundant in Shetland, where it runs into a thickened and nearly orbicular form (*C. crassa*, D'Orb.); also at Skye, Whitehaven, &c. It occurs fossil at Turin, Palermo, and Bordeaux; and indeed usually accompanies *Nonionina*.

20. *Valvulina triangularis*, D'Orb. Pl. XI. figs. 15, 16.

Valvulina triangularis, D'Orb. Ann. Sc. Nat. vii. p. 270. no. 1; Modèles, no. 25.

Shell opaque and arenaceous, red with rust-coloured particles with which it is studded. In the young state, circular and conical; cone broad at the base, and somewhat concave both at sides and base; basal edge sharp; apex of cone formed of the relatively large globular first chamber, and almost separated from the rest by a slight constriction. Cone formed of 7 or 8 flattish, almost semicircular chambers, increasing rapidly in size, arranged in a spiral manner; three chambers completing each circuit of the spire; and three being exposed at the base of the cone (youngest portion of the shell). Aperture an irregular slit, under the central two-thirds of the edge of chamber, and accompanied by a slightly raised lip or "opercular valve."

This form is small and rare in the Norway dredgings; but it occurs of larger size in Australia, and comparatively gigantic in some of the French Tertiaries (Hautville, &c.). It is common also in the West Indies. The cone in these instances varies considerably in its relative proportions, but always retains its characteristically globular apex (first chamber). A more highly developed form of the species (which always presents an arenaceous condition of shell) occurs in company with the conical form in Australia and the West Indies, and also in the French

Tertiaries. In this case, numerous individuals exhibit a gradual replacement of the cone by a trihedral (*Verneuilina*-like) series of chambers, which are ultimately produced collaterally and unequally in a spiral (*Bulimina*-like) arrangement, and exhibit a terminal fold-like aperture protected by an opercular tongue (as in *Valulina*).

This interesting species, which is a trochiform Textularian *Rosalina* in its young state (figs. 15 & 16), and presents a combination of *Verneuilina* and *Bulimina* in its advanced growth, appears to have only the Valvuline condition of its aperture as a permanent character throughout*.

D'Orbigny's *V. triangularis* (illustrated by his *Modèle*, no. 25) is this form at an intermediate stage, when the *Verneuilina* has prevailed over the *Rosalina*, and begins to lose its triangularity previously to being superseded by the *Bulimina*.

21. *Bulimina marginata*, D'Orb. Pl. XI. figs. 35-40.

Bulimina marginata, D'Orb. Ann. Sc. Nat. vii. p. 269. no. 4. pl. 12. f. 10-12.

Bulimina ovula, D'Orb. Voy. Am. Mérid. Foram. pl. 1. f. 10, 11.

Bulimina caudigera, D'Orb. *ib.* p. 270. no. 16; *Modèles*, no. 68.

Shell varying from ovate to fusiform, formed of numerous chambers arranged alternately on a ternate plan, and affecting somewhat a spiral arrangement. The earlier chambers much less in size than the later ones, and sometimes obscured by their excessive backward overlapping (as in figs. 36 & 37; still more so in *B. caudigera*, D'Orb.). The larger and later chambers are subglobose or somewhat oval in their external outline. The aperture is distinctively a little loop-shaped niche, formed, as it were, by the folding-over and convergence of the two halves of the extremity of the chamber; it is sometimes provided with a little, narrow, internal, tubular neck.

The shell, in the small varieties here figured, is hyaline and very diaphanous. In larger individuals the shell becomes thicker, coarser, and densely studded with sand-grains. The external ornament appears to be generally confined to the fringing of the posterior portion of some or all of the cells with prickles of variable size, and of very inconstant occurrence on nearly all the varieties. In figs. 39 & 40, this fringing is well shown, and the shell of this most-prickled variety is stronger than the others; whereas in the ovate and elongated forms (figs. 35 & 36) the shell is of extreme tenuity; certainly as thin as in any Foraminifera we have yet examined. The emaciated variety, fig. 35, does not put on prickles.

* *Clavulina* appears to afford an analogous interchange of structural types; but it ultimately takes on a Nodosarian, instead of a *Bulimina*-like growth; retaining a Valvuline aperture.

The extremely elongate form, with small cells, fig. 35, is well linked to the gibbous large-celled varieties by gradual intermedia, although the numerous *Bulimina* of the Norway dredgings have not supplied so many of these links as we find in the Skye sands and in some Tertiary deposits. This elongate form is usually of very small growth, and apparently in a starved or arrested condition.

The varieties above referred to are common in the Tertiary deposits of San Domingo, and in other Tertiaries; and occur recent* at Bombay Harbour, Skye, Shetland, &c. The gibbous form, fig. 36, is abundant in the London Clay.

22. *Uvigerina pygmæa*, D'Orb. Pl. XI. figs. 41, 42, 43.

Uvigerina pygmæa, D'Orb. Ann. Sc. Nat. vii p. 269. pl. 12. f. 8 & 9; Modèles, no. 67.

This shell is usually elongate, frequently trihedral, with the faces somewhat concave; it is composed much in the style of *Bulimina*, but with the spiral arrangement less marked. It is hyaline, but thick; usually ribbed; sometimes partially ribbed, or bristled with little aciculæ, or even quite smooth. The aperture is produced, instead of being sunken; and it is tubular, and sometimes neatly rimmed.

The larger varieties have the most globose chambers, more especially representing the shape of a grape-bunch (whence the name). The typical form seems to be of this well-grown variety.

Neither the variations of shape, size, or ornament† appear to us to be sufficient distinctions for the separation of the varieties into species. The gradual setting-on of riblets is well shown in pl. 11. For. Foss. Vienn., where *U. pygmæa* and its allies are figured.

Uvigerina is abundant on every coast, and in very many Tertiary deposits. It is not rare in the Norwegian dredgings.

23. *Textularia sagittula*, Soldani, sp. Pl. XI. figs. 44 & 45.

Polymorphismum Sagittulum, Sold. Testac. ii. p. 120. pl. 133. fig. T.

Textularia Sagittula, DeFrance, Dict. Sc. Nat. pl. . f. 5; D'Orb. Ann. Sc. Nat. vii. p. 263. no. 20.

Textularia aciculata, D'Orb. Ann. Sc. Nat. vii. p. 263. no. 15. pl. 15. f. 1-4.

Textularia pygmæa, D'Orb. Ann. Sc. Nat. vii. p. 263. no. 13; Modèles, no. 7.

Shell usually more or less triangular in outline, varying from

* *Bulimina auriculata* and *B. turgida*, Bailey (Smithson, Contrib. vol. ii. figs. 36-38), evidently represent the form we have here figured; and are also accompanied by the emaciated form (*B. compressa*, Bailey).

† These exogenous growths of riblets, spines, &c., evidently representing permanently the folds or points of the enveloping sarcode, are not of a specific character.

a compressed form, like an arrow-head, to a thickened wedge-like shape. The chambers, which are arranged in two rows, one on each side of the long axis of the shell, and placed alternately, imitate the folds of a braid or plait. Shell generally flattened, but sometimes rounded and conical (as in *T. trochus* of the Chalk). Chambers more or less depressed and oblong, set on at various angles in different individuals: in fig. 44 (*T. Sagittula*) they are horizontal or transverse, at a right angle to the axis of the shell; in fig. 45 (*T. aciculata*) they are at an angle of about 60°. These are nearly extreme varieties; the intermediate gradations are numerous and gentle. The thicker varieties have the greater horizontality, and the flatter or thinner forms more angularity in the arrangement of the chambers. In the former the chambers are sometimes globose (*T. gibbosa*, D'Orb.); in the latter the edge of the shell becomes a very sharp lamina, sometimes produced, and even jagged or dentate, passing into *T. Pala*, Czjzek (Haidinger's Abhandl. ii. p. 148. pl. 13. f. 15, 16), and *T. carnata*, D'Orb. (For. Foss. Vienn. pl. 14.* f. 32-34). The aperture is constant in its character of a transverse semi-lunar slit on the inner edge of the chamber (as in *Nonionina*).

In the smaller forms of *Textularia*, the shell is hyaline and perforated with numerous passages for pseudopodia; but the clear substance of the shell becomes opaque as the individuals increase in size, until the original structure is almost lost to view, by foreign particles (such as minute *Foraminifera*, sand, or prismatic cells of Molluscan shells) becoming agglutinated into the substance of the shell.

Textularia is represented by a vast variety of forms, most of which are cosmopolitan in their range, and traceable far back in geological age, even to the palæozoic periods. It is difficult to divide these varieties into specific groups. The specimens here figured, however differing in size and form, occur, with a full complement of intermediate gradations, in the Tertiary beds of Palermo, and are not specifically distinct. Similar forms are common in the British, Mediterranean, Australian, and other sea-sands. The Norwegian individuals are numerous.

Miliola et Miliolites, Lamarck. Pl. X. figs. 28-37.

24. *Biloculina ringens*, Lamarck, sp. Pl. X. figs. 28-33.

Miliolites ringens†, Lam. Ann. Mus. v. p. 351; ix. pl. 17. f. 1.

Biloculina ringens, D'Orb. Ann. Sc. N. vii. p. 297. no. 2.

* This plate affords an interesting series of these varying forms of *Textularia*.

† The specimen figured by Lamarck has lost its outer chamber, the laminar tongue of which remains in place, and appears as an appendage to the shell.

Biloculina bulloides, D'Orb. Ann. Sc. N. vii. p. 297. no. 1. pl. 16. f. 1-4 ;
Modèles, no. 90.

Pyrgo laevis, Defr. Dict. Sc. Nat. pl. 88. f. 2.

Biloculina laevis, D'Orb. Ann. Sc. N. vii. p. 298. no. 8.

Biloculina aculeata, D'Orb. Ann. Sc. N. vii. p. 298. no. 3 ; Modèles, no. 31.

Biloculina depressa, D'Orb. Ann. Sc. N. vii. p. 298. no. 7 ; Modèles, no. 91.

Shell ovate, gibbous or compressed, white, opaque, smooth or sometimes delicately striate (fig. 32), sometimes roughened by fine granulation ; externally showing two loculi or chambers, the larger (last) one overlapping the edges of the penultimate chamber ; the internal chambers formed on the same plan. Chambers few (six to nine), disposed parallel to the long axis of the shell, regularly alternating on one side and the other, cochleate, of a more or less ovate outline and convex externally, resembling the bowl of a spoon with the edges strongly incurved ; the edges of each chamber fitting over the edge of the shell constructed by earlier chambers. The chambers have no inner wall of their own*. The aperture is a transverse terminal slit, modified and encroached upon by a tongue-like lamina on its inner side.

This shell varies from the striking globosity of the finely striated variety (figs. 32 & 33) to the flatter and oval form (figs. 30 & 31) : a much greater degree of flatness obtains in specimens collected from other sea-sands (*B. depressa*, D'Orb.) ; and, on the contrary, a lateral compression gives rise to another extreme form in *B. contraria*, D'Orb. Occasionally, from the varying amount of overlapping of the outer chamber, either full or meagre at the edges, the general outline is variable. In fig. 30 the shell is subquadrate in outline, and almost three-lobed on one of its surfaces, owing to the deficiency of one part (base) of the last chamber, and the swollen condition of its two overlapping edges. In fig. 31 we have a side-view of a form intermediate, by its partially-swollen sides, between figs. 28, 29, & 30. (*B. chyeata*, *B. simplex*, and *B. inornata*, D'Orb., are varieties amongst these Norwegian *Miliola*.) Fig. 32 differs by its greater globosity and by its striation from the other *Biloculinae* here figured ; the latter character is rare in *Biloculina* : judging, however, from the uncertainty of ornamentation in other *Foraminifera*, especially *Quinqueloculina*, this character of striation is scarcely available for specific value.

Biloculina is very common in the recent and the Tertiary sea-sands, and has supplied numerous so-called "species" to authors. The forms, for instance, figured by D'Orbigny in his 'Foram. Foss. Bass. Vienne,' pl. 15 & 16, may be advantageously studied in this light.

* The tongue-like plate in the aperture of the shell is apparently the only representative (or homologue) of the inner wall of each segment.

In the Norway dredgings the common *Biloculina* (such as figs. 28, 29, 31) are numerous from 30 fathoms, and amongst them there were two distorted specimens (such as fig. 30); three specimens of similar smooth *Biloculina*, but larger in size, came from the 70–100 faths. dredging; and three specimens of the globular and striate variety (figs. 32, 33) occurred at 160 faths.

25. *Quinqueloculina Seminulum*, Linn. sp. Pl. X. figs. 34, 35, 36.

Serpula Seminulum, Linn. Syst. Nat. ed. 12. p. 1264.

Vermiculium intortum, Montagu & Fleming.

Quinqueloculina Seminulum, D'Orb. Ann. Sc. N. vii. p. 303. no. 44.

Quinqueloculina secans, D'Orb. *ib.* p. 303. no. 43; Modèles, no. 96.

Triloculina? oblonga, Montagu, sp. Pl. X. fig. 37.

Vermiculum oblongum, Montagu, Test. Brit. p. 522. pl. 14. f. 5; Fleming. Wern. Mem. iv. p. 565. pl. 15. f. 4.

Triloculina oblonga, D'Orb. Ann. Sc. Nat. vii. p. 300. no. 16; Modèles, no. 95.

Shell more or less oval or ovate, and compressed; resembling *Biloculina* in the whiteness and opacity of its substance, and in its mode of building-up, except that the chambers are not set on regularly on one plane, nor overlap so completely at their edges; the chambers not being expanded, as is usual in *Biloculina*, but narrow and crescentic; and the overlap of their edges being greater on one side than on the other. This asymmetry gives rise to the exposure of parts of either the edges or faces of the earlier chambers on the two surfaces of the shell; and generally one more chamber is visible on one surface than on the other;—as many as six or five on one, and five or four on the other (*Quinqueloculina*), or as few as three and two (*Triloculina*).

The aperture is semioval, with a tongue-like internal lobe, which is frequently bifurcate.

Quinque- and *Tri-loculina* are excessively variable shells*, both as to shape and ornament, and are amongst the most common Foraminifers in all latitudes and depths.

We have no genuine *Triloculina* in the Norway dredgings. Fig. 37 is the so-called *Triloculina oblonga* of authors; but it is rather a contracted ill-grown *Quinqueloculina* than a true *Triloculina*. It usually abounds with the *Q. Seminulum*.

The *Miliolæ* were as common in the Tertiary seas as at present; they appear to be rare in the Chalk; but are not unfrequent (as *Quinqueloculina*), though of small size, in the Gault. Various individuals are common in one or other of the Norway dredgings. Fig. 34 is from 30 fathoms; figs. 35 & 36 from

* The plates 16–20 of the 'For. Foss. Bass. Vienne' offer a large series of *Milioline* forms for study.

160 fathoms; and similar forms occur at 40, 60, and 70–100 fathoms. Fig. 37 is from 30 fathoms, and was accompanied by two similar specimens.

26. *Placopsilina Canariensis*, D'Orb., sp. Pl. X. figs. 13, 14.

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|--------|---|---|
| Free. | { | <i>Nucleus minusculus limosus</i> , &c., Soldani, Saggio oritograf. p. 99. pl. 1 f. 10. |
| | | <i>Nonionina Canariensis</i> , D'Orb. Hist. Nat. Canaries, p. 128. pl. 2. f. 33, 34. |
| | | <i>Spirolina æqualis</i> , <i>S. lagenalis</i> , <i>S. irregularis</i> , Roemer, Nordd. Kreid. p. 98. pl. 15. f. 27–29. |
| | | <i>Spirolina irregularis</i> , Reuss, Böhm. Kreid. i. p. 35. pl. 8. f. 62–66, 75. |
| | | <i>Spirolina agglutinans</i> , D'Orb. For. Foss. Vienn. p. 137. pl. 7. f. 10–12. |
| Fixed. | { | <i>Spirolina Humboldti</i> , Reuss, Zeitsch. deutsch. geol. Ges. iii. p. 65. pl. 3. f. 17, 18. |
| | | <i>Nonionina silicea</i> , Schultze, Müller's Archiv f. Anat. 1856, p. 171. pl. 6 B. f. 4–6. |
| | | <i>Œufs de Mollusques</i> *, Cornuel, Mém. Soc. Géol. France, 2 sér. iii. pl. 4. f. 36. |
| | | <i>Placopsilina scorpionis</i> ?, D'Orb. Prodrôme Paléont. i. p. 259. no. 283. |
| | | <i>Placopsilina Cenomana</i> ?, D'Orb. <i>ib.</i> ii. p. 185. no. 758. |
| | | <i>Placopsilina Cenomana</i> , Reuss, Vienna Transact. vii. p. 71. pl. 28. f. 4, 5. |

In our figured specimen the shell is discoidal, obtuse at the margin, sunken at the umbilicus on each surface; chambers triangular on side-view; increasing slowly in size; about nine in number in the outer whorl; slightly overlapping the former whorls. Shell rusty in colour, opaque, arenaceous, the calcareous material small in proportion to the imbedded sandy matter, which is considerable in quantity.

One large individual (figs. 13 & 14; from 30 fathoms, Finmark) and a few small ones have occurred in the Norway sands. We have also found this Foraminifer in a few other dredgings from the northern seas. Sometimes it is more depressed than the specimen figured.

The *Nonionina*-shaped shell here figured belongs to the same genus as the crosier-shaped and *Spirolina*-like shells known as *Spirolina*† *irregularis*, &c., as well as the more irregular and attached Foraminifers to which the term *Placopsilina*‡ is more especially adapted. In all these the shell is arenaceous; the chambers are more or less closely set, usually increase very gradually in size, and commence in a spiral arrangement, but sooner or later go off in a straight direction, with much irregu-

* Together with these are figured (*loc. cit.* fig. 37) some *Webbina*. As *Webbina* is probably distinct from *Placopsilina*, we leave it for future consideration.

† The *Spirolina* of Lamarck (*S. cylindracea* and *S. depressa*) are contracted varieties of *Peneroplis*, with the typical forms of which *Spirolina* is united by *Dendritina*. All these retain their homogeneous shell-substance without becoming arenaceous; they have also other peculiarities of structure.

‡ D'Orbigny, Cours Élément. Paléont. vol. ii. p. 199, 1852.

larity. The aperture in the nautiloid forms is usually near the lower part of the chamber, but occasionally almost central; it is large, usually transverse and semilunar; frequently jagged in outline or irregularly lobed, and occasionally compound (therein approaching that of *Lituola*, which, with its divided chambers, is to *Placopsilina* * as *Orbiculina* is to *Peneroplis*).

The aperture in the straight part of the crosier-shaped individuals is central and usually round. In all cases the aperture is faintly lipped.

The chambers (as usual in the non-hyaline Foraminifera) are set one on another by their edges, like tents or inverted cups, not like bladders or bottles; and, when the animal grows in the fixed condition and is flat, the chambers are more or less deficient of substance on the attached side. In the attached form it is *Truncatulina*-like at first, but passes off into an irregular serial growth of transversely broad but unequal chambers.

A characteristic of the recent specimens is the yellow or ferruginous tint† of the shell, arising from the colour of the sandy particles which enter so largely into its composition.

Either in the nautiloid or the crosier-like forms, this shell is known to us in the Oxford Clay, Gault, Chalk-marl, and Chalk; and authors quote it from the Chalk of Europe, the Tertiary of Coroncina (Italy), of Hermsdorf (near Berlin), and from existing seas. The fixed forms occur abundantly in the Jurassic‡ and Cretaceous deposits.

EXPLANATION OF PLATES X. AND XI.

PLATE X.

[All the figures (except fig. 12) are magnified about 12 times linear.]

Fig. 1. *Cristellaria Calcar*; attenuated variety. 2. The same; edge-view of last chamber.

Fig. 3. *Dentalina communis*; fragment. 4. Last chamber of another specimen. 5. The same; external aperture.

Fig. 6. *Nodosaria lævigata*. 7. The same; external aperture.

Figs. 8, 9. *Nodosaria lævigata*; varieties.

Fig. 10. *Cristellaria Calcar*. 11. The same; edge-view. 12. The same; external aperture; more highly magnified.

* *Placopsilina* may be said to represent, among the non-hyaline Foraminifera, the *Acervulina* among the hyaline forms.

† This yellow tint characterizes also the so-called *Nonionina pelagica*, D'Orb. (Voyage Amér. Mérid. vol. v. part 5. pl. 3. f. 13, 14), which is apparently closely allied to *P. Canariensis*, but far more gibbous, with inflated and rapidly enlarging chambers.

‡ It is abundant on the *Ostræa Marshii* of the Inferior Oolite near Peterborough.

- Fig. 13. *Placopsilina Canariensis*. 14. The same; edge-view (somewhat obliquely placed).
 Fig. 15. *Anomalina coronata*. 16. The same; edge-view.
 Figs. 17, 18, 19. *Truncatulina lobatula*. 20. The same; flat surface or base. 21. The same; edge-view (somewhat obliquely placed).
 Fig. 22. *Rosalina vesicularis*. 23. The same; edge-view. 24. The same; flat surface, or base.
 Fig. 25. *Polymorphina communis*. 26. The same; edge-view, showing the additional lateral apertures. 27. The same; terminal aperture.
 Fig. 28. *Bilucina ringens*. 29. The same; edge-view. 30. A distorted individual. 31. The edge-view of a somewhat depressed form. 32. The edge-view of a finely striated variety. 33. The surface of outer chamber of young individual of the striated var.
 Fig. 34. *Quinqueloculina Seminulum*. 35. Another individual. 36. The end-view of another. 37. The contracted variety.

PLATE XI.

[The figures are magnified about 12 times linear.]

- Fig. 1. *Dentalina communis*, var. Fragment. [Drawn upside down.]
 Fig. 2. *Vaginulina*? Fragment. [Drawn upside down.]
 Fig. 3. *Operculina complanata*. 4. The same; edge-view.
 Fig. 5. *Nonionina crassula*. 6. The same; edge-view.
 Fig. 7. *Nonionina communis*. 8. The same; edge-view (oblique).
 Figs. 9, 10. *Nonionina bulloides* (obliquely placed).
 Fig. 11. *Globigerina bulloides*; lower surface, or base. 12. The same, upper surface.
 Fig. 13. *Rosalina vesicularis* (young); lower surface. 14. Another individual; upper surface.
 Fig. 15. *Valvulina triangularis* (young or trochoid form); base. 16. The same; apex (obliquely placed).
 Figs. 17, 18. *Cassidulina lævigata*.
 Fig. 19. *Polystomella crispa*.
 Figs. 20, 21. *Nonionina asterisana*.
 Figs. 22, 23, 24. *Lagena lævis*, varieties.
 Figs. 25-29. *Entosalenia globosa*, varieties.
 Figs. 30, 31. *Polymorphina communis*; young form. 32. Gibbous form (*P. gibba*). 33. Attenuate form (*P. lactea*). 34. External stag-horn tube.
 Fig. 35. *Bulimina marginata*; attenuate variety. 36, 37. Overlapping variety. 38, 39, 40. Aciculate variety.
 Figs. 41, 42, 43. *Uvigerina pygmæa*.
 Fig. 44. *Textularia Sagittula*. 45. The same; var. *aciculata*.
 Fig. 46. *Spirillina vivipara*.

XXII.—Notes on the Permian System of the Counties of Durham and Northumberland. By RICHARD HOWSE, South Shields.

[Continued from p. 52.]

CONCHIFERA.

17. *PECTEN PUSILLUS*, Schloth.—The author of the 'Perm. Monog.' has, in translating Goldfuss's specific description of this little shell into his 'Monograph' and into English, made a little too free with the Latin original. In the 'Monog.,' "*antica valvæ dextræ majori subplicata*" is rendered, "the fore part of the right valve in a great degree subPLICATE." Now this is both contrary to fact and to Goldfuss's German description as well as to the Latin, and might lead to a little confusion hereafter.

This *Pecten* is described as smooth by all authors, and such is its most general appearance; but when the shell is perfect and well preserved, there are to be seen all over its outer surface fine striae of growth running parallel to the lower margin. Also on many specimens numerous fine lines radiate from the umbones to the same margin. The hinge-line is furnished in some individuals with an area of comparatively great size, but generally it is so small as not to be observable.

Some specimens of a *Pecten* which are found in a peculiar yellow conglomerate near Gera in Germany have lately been elevated into a species by Baron Schauth under the name of *Pecten Macrothi*. I have examined some fragments of this shell obligingly sent to me by this learned Permian palæontologist, and I am sorry that I am obliged to consider the distinguishing character which he has pointed out as not of sufficient value to constitute a species. The chief character mentioned as peculiar to this new shell is the distant, very flat lines of growth parallel to the margin. But this is, as above stated, the perfect appearance of the surface of *Pecten pusillus*, to which the *Pecten Macrothi*, I have no doubt, belongs.

This species occurs most abundantly in the shell-limestone of Humbleton, and sparingly in all the other localities mentioned in the Table. It is also stated in the 'Perm. Mon.' to occur in the compact limestone at Whitley and Tynemouth.

17a. *LIMA PERMIANA*, King.—Though I had taken single valves of this shell many years ago, yet the slight distinguishing characters it presented have always prevented me from considering it distinct from the preceding. But Mr. Kirkby has, with his usual success, obtained such a fine series of it from the places mentioned in the Table, that its admission into the fauna can be no longer safely resisted. It has also been discovered by Baron

Schauroth at Poessneck; and some examples kindly sent me for comparison agree with ours in every particular.

It differs from the preceding chiefly in the obliquity of the valves, in the narrowness of the hinge-line, and the more triangular appearance of the area. It has also no byssal notch. The surface, in perfect specimens, is ornamented with fine parallel lines of growth, and small radiate depressions run from the umbones to the margin. For the present, it may be left in the genus *Lima*, but this requires further examination.

In the shell-limestone of Tunstall and other localities; not very common.

18. *MONOTIS SPELUNCARIA*, Schloth.—Certainly no one at all conversant with this pre-eminently characteristic Permian bivalve can assent to its being unnecessarily broken up into three species, as proposed by the author of the 'Perm. Mon.'

As pointed out in the Tyneside Catalogue*, the convex valve when perfect exhibits "a few strong, unbricated or granulated diverging ribs, between which there are others much finer and closer together." The granulations are strongest on one side of the valve, and occur only on those specimens that are of very regular growth. On the coarser and larger individuals the ribs are covered with strong imbricating processes, which are oftentimes considerably produced. These characters correspond with those given by Dr. Geinitz in his 'Versteinerungen,' but *Avicula Kasanensis*, Geinitz, can only be reckoned a coarser variety of this species.

It is not common in the compact-limestone, but sometimes occurs very plentifully in the shell-limestone of Humbleton and other localities. In the higher deposits it has never been known to occur.

19. *GERVILLIA ANTIQUA*, Münst. = *G. INFLATA*, Brown, sp.—At present I am unable to decide which of the above names ought to be retained for this species, as the figures given by Goldfuss are not very good representations of it, and are referred by Dr. Geinitz to the following, *G. ceratophaga*. Many other eminent naturalists also are of opinion that *antiqua* is only a variety of the latter; but I am not at liberty at present to adopt this opinion.

It is altogether a very much broader and a more inflated shell than the following species. The posterior margin is never so much arcuated or forked, and the wings are never so strongly and distinctly marked off from the body of the shell as they are in *G. ceratophaga*. The cartilage-pits, generally three or four

* Through an unfortunate oversight, an erroneous date was given to the publication of this Catalogue in a former number of the 'Annals.' Instead of Aug. 10th, read Aug. 17th, 1848.

in number, arc, from increasing in width with the growth of the hinge-margin, rather triangular, and are placed directly across the area. They are never oblique in the specimens I have examined, as represented in the 'Perm. Mon.,' and the first pit invariably stretches directly between the umbones. In the clumsily-grown *tumida*, which is only a stunted form of this species, they are placed closer together and are more numerous, though the hinge-line is much shorter. In the Table, the *Bakevelli* *carinata*, King, has been placed erroneously as a synonym of the next shell; but it is only the young of the present species, which has oftentimes two strong, raised, diverging lines running from the umbones to each side of the byssal notch.

Through the kindness of Mr. Binney I have made the following notes on Capt. Brown's species of *Avicula*:—

The three specimens of *Avicula Binneyi* belong undoubtedly to the *A. antiqua* of the Durham magnesian limestone. *A. inflata* is identical with the preceding. The hinge-area is very much inclined, perhaps from the valves being partially open. The only difference perceivable in *A. discors* is that the area is not so much developed, and the umbones are closer in consequence. The right valve also appears smaller than usual, but this may be from compression. Two other specimens of *A. antiqua* in the same collection were much larger and better preserved than the preceding. They have the posterior margin also more forked, and there is a deepish constriction running from the umbones to the ventral margin.

Great development of the hinge-area cannot be considered a specific character in this species, nor in some of the following; for when this area is greatly increased, there is generally a very stunted growth of some other part of the shell.

This species and the following may be very safely and most conveniently placed in the above genus. There seems to be no necessity for instituting a new one for their reception.

In the compact-limestone rare, but rather plentiful in some localities in the shell-limestone. In this district it has not yet been detected in the higher members of the limestone, which are probably the true equivalents of the Permian marls of Manchester and its neighbourhood, where this little shell seems to be very common.

20. *GERVILLIA CERATOPHAGA*, Schloth.—It is of a more elegant form than the preceding, and the tumid part of the shell is more distinctly characterized and produced to a greater length posteriorly than in the *G. antiqua*. The hinge-line is very long, and produced posteriorly to a fine point, whence it curves beautifully downwards, forming a deep curve with the tumid part of the

shell. The hinge-area is not so broad and more parallel than in the foregoing species, and its cartilage-pits, placed directly across the margin, and not obliquely to it, as described in the 'Monograph,' have an oblong appearance. The first pit is placed immediately between the umbones, and only in one instance have I seen more than three, though it is stated by Mr. King that there are sometimes six. This species is very imperfectly represented in the 'Perm. Mon.,' for not one of the figures gives a correct idea of the perfect appearance of this shell; and the cartilage-pits are represented as being oblique, which is quite contrary to what I have always observed. The *Bakevelta Sedgwickiana* cannot be considered even as a variety of this species. The surface of *G. antiqua* and *ceratophaga* is, when perfect, covered with beautiful, raised, distant lines; and this is the commonest style of shell-ornament that occurs in the Permian rocks.

It is rather common in the shell-limestone of several localities.

21. *MYALINA HAUSMANNI*, Goldfuss.—It seems advisable to adopt the specific name given to this shell by Goldfuss, as it is the first that is accompanied with a good description and figure. It has very often been mentioned, under another name, in a few English works, but we have no accurate or admissible description of it, and no figure that I am acquainted with that can claim earlier date than those in the 'Perm. Mon.' The above is a well-established name on the continent, and has been so for very many years.

It is not possible any longer to separate this common shell into two species, for there is no character by which they can be distinguished specifically. The examples that occur in the lower and middle beds of limestone are narrower and appear more elongated than those which occur in the upper deposits. The latter are generally broader and more ovate in form, but in all essentials they are alike. They have all occasionally the ligamental area very much produced; but this is not a specific character, for individuals often occur with a narrow hinge-line. The squamose appearance of these shells is not the true outer surface, for the latter is most beautifully adorned with very fine and regular lines of growth. It is only in finely preserved specimens from the upper beds that this character is shown to perfection, but it may be traced on very many specimens from the shell-limestone.

The existence of this mytiliform shell in such great plenty in the shell-limestone, and its generally rough and stunted appearance, would seem to lead to any other than the conclusion that this deposit of shell-limestone was of 'pelagic' origin. The entire fauna of this limestone is indeed so decidedly littoral in character, and so clearly of shallow-water origin, that I could

not, many years ago, refrain from pointing it out, and no statement has been made since that invalidates this conclusion.

This species is most abundant in the shell-limestone, and occurs sparingly in many of the upper beds of limestone.

22. *MACRODON STRIATA*, Schloth.—The form of the teeth of this shell agrees with that of *Macrodon*, Lycett and Morris, and the general shape is also very similar. The hinge-area is often very much developed in specimens whose growth is somewhat stunted round the free margins of the shell. This is the form best known in England (*Arca tumida*, Sow.). The regularly-grown shell is one of the most beautiful, both in form and ornament, of those from the Permian rocks. The smooth or partially smooth examples, *A. Kingiana*, can often be traced on the umbonal regions of genuine *M. striata*. The specimens figured in the 'Perm. Mon.' give a very poor idea of the shape and beauty of ornamentation of this common species.

In the shell-limestone, rather common at Tunstall, and occurring frequently in all the localities mentioned in the Table. It appears to be a much commoner species in England than in Germany.

23. *LEDA SPEIUNCARIA*, Geinitz.—It is not to be disputed that Geinitz's figure and short description of this little shell have priority over Mr. King's: therefore I feel no hesitation in adopting it, although it is placed among the synonyms in the 'Perm. Monograph.' It occurs rather sparingly in the upper beds of limestone, and more rarely in the shell- and compact-limestone.

The *Nucula Tateiana*, King, is mentioned here that it may not be lost sight of. It is impossible to adopt it as an authenticated species, for, according to Mr. King's own words, the description is drawn up from "the dorsal half" of a specimen only. Baron Schaueroth has favoured me with some specimens of a true Permian *Nucula* (*N. Beyrichi*) from the Zechstein of Germany; and this renders it very likely that on some future occasion specimens may occur in our limestone.

24. *SOLEMYA NORMALIS*, Howse. Pl. IV. fig. 7*.

"Shell transversely oval, narrow, slightly arcuated; beaks indistinct near the posterior end; anterior (much) elongated; muscular impressions large, slight; a few raised lines diverging from the beaks to the free margins on the east; external surface smooth."

I obtained a single left valve of this very rare shell on a block of Humbleton Hill shell-limestone, on Good Friday, 1845. I afterwards described it, in the above words, in the Tyneside Catalogue. It was there pointed out, that though it bears a slight resemblance to *S. biarmica*, yet the beak is nearer

* The figure in the accompanying plate does not represent the rounded appearance of the anterior extremity as correctly as could be desired.

the posterior end, and the shell is much narrower than in the Russian species. The anterior is also more elongated, and the surface is quite smooth. It is also very much smaller. All these differences are borne out by another single left valve lately found by Mr. Kirkby at Tunstall.

Mr. King had the loan of the above specimen for several months; and I find he has, in the 'Perm. Monog.,' attempted to describe and to figure a species which he identifies with this. But he has succeeded very badly, both in the description and in the figure, which does not represent my species. Baron Schaueroth has attempted, in one of his excellent papers, to identify a German specimen with Mr. King's description and figure; but he found so little character in the latter, that he was obliged to leave the matter in doubt. Certainly the *S. Phillipsiana*, King, is not worthy to be considered even a synonym.

Two left-valves have been found in the shell-limestone of Tunstall and Humbleton.

25. *SOLEMYA ABNORMIS*, Howse. Pl. IV. figs. 8, 9.

"Shell transversely oval; beaks not prominent; posterior short, narrow, rounded; anterior elongated, rounded, much wider than the posterior; surface slightly waved concentrically, plain; muscular impressions obliquely placed, deep."

So different did this *Solemya* seem when I first described it, that I never for a moment thought of drawing a comparison between it and the *S. biarmica*; and although I have received some fine casts of German specimens of the latter, I must own that I cannot identify them with either of the above species. The *S. abnormis* is very pointed posteriorly, and the anterior is much produced and very broad. It is also much flattened, and all the specimens I have examined are quite smooth. The German casts are rather tumid, slightly arcuated, and have the valves rounded and covered with strong lines of growth near the anterior margin. It is therefore very doubtful whether the shells placed as synonyms in the Table are referable to this species.

It cannot certainly be referred to the *S. biarmica*, Vern., of the Russian Permian rocks, until it be known whether that species really is a gaping shell or not. With these uncertainties, I hesitate to alter the name originally given to it in the Tyneside Catalogue.

It remains to be stated, that Mr. King identifies this species with the *S. biarmica*; but the figure given in the 'Perm. Mon.' pl. 16. fig. 7, represents no *Solemya*, but a young specimen of the *Allorisma elegans*, King.

I have taken specimens of the above shell at Whitley, in the compact-limestone; at Tunstall and Silkworth, in the shell-limestone; and Mr. Kirkby has recently obtained a specimen from Humbleton.

26. *AXINUS* DUBIUS, Schloth.—Baron Schaueroth has recently shown that the specific name *dubius*, originally applied to this shell by Schlotheim, has priority of all others, even of the now well-known Sowerbian epithet *obscurus*. It is therefore necessary to adopt this so-long-neglected name.

Under this name there may be very conveniently placed the following species of authors:—*Axinus obscurus*, Sow.; *A. parvus*, *pusillus*, *productus*, *undatus*, *elongatus*, *rotundatus*, and *Lucina minima*, Brown; *Schizodus Schlotheimi*, Geinitz, and *Schizodus truncatus*, King.

Remarks on Mr. Binney's Specimens.—Two small casts of *Ax. parvus* belong without doubt to the above.—*A. productus* resembles the form which King has separated under the specific name *truncatus*. It is rather more produced in front, and more truncated behind. It cannot claim to be more than a regular growth of *dubius*.—*A. undatus* and *A. elongatus* belong also to the above. They present no peculiar characters.—*A. pusillus* and *Lucina minima* appear to be the young of the foregoing species.

In the 'Perm. Mon.,' under four specific names (pl. 15. f. 23–32), are very good representations of some of the forms of this characteristic species; but the peculiar ornament of the shells of this genus is, I think, not represented.

In the upper beds of limestone it occurs of great size, some specimens being 2 inches in length. It is rather plentiful in the shell-limestone, and rare in the compact.

27. *ASTARTE*? *VALLISNERIANA*, King.—The specimens of this shell which I have collected at Whitley are rather more triangular than the figure in the 'Perm. Mon.,' and very much resemble, both in the general form and ornament of the valves, some young specimens of the recent *Venus striatula*. The hinge-line is furnished with a deep triangular cartilage-pit, and the character of the superficial ornament is preserved on the casts.

I am not able to confirm the existence of *Astarte Tunstallensis*, King, in our limestone; and as it bears considerable resemblance to the preceding, and is not strongly characterized, its admission into the Permian fauna, as a distinct species, may be safely objected to till less equivocal specimens are obtained.

The *Astarte Vallisneriana* occurs in this district in the compact-limestone only; and, according to Baron Schaueroth, it is found in the equivalent deposit near Gera in Germany.

28. *MYOCONCHA* COSTATA, Brown.—I find nothing in the form of the teeth of this shell that requires it to be removed from the genus *Myoconcha*. So far as I have been able to ascertain, there is only one oblique cardinal tooth in the right (?) valve, which fits into a corresponding depression of the left.

The examples from this district agree very accurately with the original specimens described by Capt. Brown. In general, all the specimens are strongly marked with several oblique radiating ribs or planes over the posterior surface. Some specimens occur at Byer's Quarry quite smooth, and more ovate than usual. These have, I see, been prospectively named *Pleurophorus oratus* in the 'Perm. Mon.' They do not appear to differ specifically from the foregoing.

It ranges through all the limestone series, but is most plentiful in the shell-limestone of Tunstall and Humbleton.

29. *MYOCONCHA MODIOLIFORMIS*, King.—It has been proposed by Baron Schaueroth to unite this species with the *Modiola Pullani*, De Vern., a species which is said to be without teeth. Mr. King has also referred it to the edentulous genus *Cardiomorpha*, De Koninck. For want of Russian specimens to compare with it, I think it better to leave it under its present specific name, especially as some specimens which I have examined show an appearance of a tooth in the right valve, and its other general characters are the same as in the preceding species. It may with safety therefore be included in the same genus as *costata*.

In one of Mr. Kirkby's specimens, the ligament, which is finely preserved, is comparatively large. Some specimens of the same shell from the equivalent deposit of Poessneck, kindly forwarded to me by Baron Schaueroth, have the ligament in a fine state of preservation.

It is found in the shell-limestone only, where, sometimes associated with its congener, *M. costata*, it is rather plentiful.

30. *MYACITES ELEGANS*, King.—"Schlotheim's name *Myacites*" (writes Mr. King, 'Perm. Mon.' p. 196) "implies that the shells so called are fossil Myas: as this is not the case, the name cannot stand." And just above this note the same author states that "the name (*Allorisma*) was proposed under the persuasion that the cartilage-fulcra of the genus varied in position according to the species; this is now known to be an error: the name is, however, still retained, notwithstanding its being a misnomer." The conclusiveness of this reasoning seems to have had its effect upon all careful English naturalists, for I find *Myacites* now adopted, and *Allorisma* consigned to mere oblivion. It still, however, lingers on the Continent, shortly to become for ever extinct.

Several authors think this species is only the *Panopæa lunulata*, Keyserling; but I am not able to refer it to that species for want of original Russian specimens to compare it with. This species belongs to the genus *Myacites*, restricted as it is by Morris and Lycett.

The specimen which Mr. King has figured as *Solemya biar-*

mica, De Verneuil, Perm. Mon. pl. 16. fig. 7, is only a young specimen of *M. elegans*.

It occurs very sparingly in the shell-limestone of Tunstall and Humbleton.

31. *EDMONDIA ELONGATA*, Howse. Pl. IV. figs. 10, 11, 12, 13.

"Shell elongated oval; beaks prominent, near the anterior end; anterior short and rounded; posterior elongated, the dorsal margin on a line with the beak: surface convex, covered with strong concentric lines of growth; hinge without teeth; umbonal cavity divided longitudinally by an elongated, thin, slightly curved visceral plate, depending towards the cavity of the shell."

The above is the original description of this shell given in the 'Tyneside Catalogue.' It points out one peculiarity of this species and genus which appears to be generally misunderstood by authors:—The shelly process situated in the umbonal cavity is supposed to be a cartilage-plate, and to belong to the hinge. In Mr. Woodward's excellent Manual, it is suggested, with doubt, that the shells of this genus were furnished with an ossicle. An examination of several cross-sections of shells belonging to this genus does not appear to substantiate this conclusion. The shell also of most species is very thin, and the valves are united by a strong external ligament, as a Permian specimen from Germany and some examples of the carboniferous *E. arcuata* in my possession clearly show. It could not, therefore, require an internal cartilage of such a size. But these are, I think, not cartilage-plates, but internal processes equivalent to the subumbonal or spatula-shaped blade of the genus *Pholas*, which projects into the cavity of the shell, and forms an advanced point of attachment for a visceral, or perhaps for the pedal muscle. The general configuration of this shell also suggests that it was a burrowing mollusk.

It is not a very common species in the shell-limestone of Tunstall, Humbleton, &c., and occurs also in the equivalent deposit of Poessneck.

32. *TELLINA DUNELMENSIS*, Howse. Pl. IV. figs. 14, 15.

"Shell elliptical; beaks small, not prominent, situated near the anterior end, which is somewhat rounded; posterior elongated, more acute than the anterior; two cardinal teeth in each valve."

The specimens of the shells which I have been able to examine do not permit much to be added to the above characters. The specimen figured in the 'Perm. Mon.' is imperfect, for the posterior of this shell is rather acute, perhaps not quite so much so as in the figures, Pl. IV. figs. 14, 15. The valves are generally found together, and spread out, which is the case also with several other Permian species. It shows that they were provided with a very strong ligament.

In the shell-limestone at Humbleton.

[To be continued.]

XXIII.—List of Coleoptera received from Old Calabar, on the West Coast of Africa. By ANDREW MURRAY, Edinburgh.

[Continued from p. 161.]

[With a Plate.]

Lebiidæ.

LEBIA, Lat.

1. *L. bicolor*, Dej. 5. 366.

Rufa; elytris subsulcatis, viridi-cyaneis; geniculis nigris.
Long. $4\frac{1}{4}$ lin., lat. $1\frac{3}{4}$ lin.

2. *L. bis-binotata*, mihi.

Rufa-testacea; elytris striatis, nigris vel nigro-brunneis, margine reflexo, puncto humerali, et quatuor maculis dorsalibus, duabus anterioribus magis, duabus posterioribus minoribus, luteis.

Long. $4\frac{1}{2}$ lin., lat. $1\frac{3}{4}$ lin.

Nearly of the same form as *bicolor*. Rufo-testaceous; the elytra black, or very dark umber, with the reflexed margin, a humeral spot connected with the margin, two large roundish spots on the anterior portion of the disk, and two smaller roundish spots placed closer together, one on each side of the suture near the apex, pale testaceous. Antennæ filiform, with the three basal joints testaceous, the third darker at the base, the remaining joints dusky and pubescent, the last joint paler at the apex. Head ferruginous, longitudinally strigose in the middle; the strigations tending obliquely to the centre; two faint depressions in front; clypeus smooth; mouth rufo-testaceous; tips of mandibles darker; eyes prominent (though not quite so much so as in *bicolor*). Labrum moderate, broader than long, slightly rounded in front. Mentum toothed*. Thorax rufous in the middle, the margins pale and transparent, broadly reflexed; mesial longitudi-

* As is observed by Lacordaire (Genera des Coléoptères, i. 127), there is considerable difference of opinion among authors, whether in the genus *Lebia* the mentum has a middle tooth or not; Bonelli, Chaudoir, and others maintaining that it has; while Schiödt, Schmidt-Goebel, and Lacordaire himself are of opinion that it has not,—viewing the piece which is supposed by the former to be a tooth, as a semi-corneous plate which forms the central base of the ligula, and, in dissecting the head, is often taken off attached to the mentum, but is separable from it. That it is so in some instances, there is no doubt; as, for instance, in *Lebia cruz minor*. In other cases there is no appearance of a tooth at all, either as forming part of the mentum or the base of the ligula. *Lebia scapularis*, and other

nal line distinct, but not deep nor sharply defined; disk transversely wrinkled, a transverse depression along the produced part of the base. Scutellum testaceous, elongate-triangular, with a semilunar depression. Elytra broad, truncate and emarginate at the apex, deeply striate, with faint traces of punctures in the striae, most easily seen in the pale spots, with two larger punctures in or alongside of the third stria, one occurring in the larger pale spot, the anterior margin of which is distant from the base about a fourth of the length of the elytra, the other in the posterior small pale spot, the posterior margin of which is distant from the apex about an eighth of the length of the elytra; a row of larger circular punctures, with a slight elevation in the middle of each, runs along or between the two striae next the margin; the third and fourth, and the fifth and sixth striae show a tendency to unite at the apex, and the seventh turns in at the apex and runs towards the suture, terminating opposite the third stria in a large circular puncture with a central elevation; the eighth and ninth striae also turn towards the suture at the apex, but are speedily effaced. The suture is testaceous at the base, and slightly so along its edge the whole way. The testaceous spot on the shoulder does not encroach on the elytra so far as the point of the scutellum; the testaceous reflexed margin does not reach to the apex; the larger testaceous spot extends across four interstices, commencing at the second stria; the smaller spot extends across three interstices, commencing at the first stria. The under side is pale testaceous yellow, shining, with a few scattered punctures on the segments of the abdomen, from which spring hairs; the legs are of the same colour; claws pectinate.

3. *L. clavicornis*, mihi. Pl. XII. fig. 1.

Convexa, tumida, læte carnea, semitranslucens; antennis compressis, incrassatis versus apicem, nigris, ferrugineis ad basin; elytris leviter striato-punctatis; pedibus concoloribus; geniculis, apicibus tibiæ atque tarsis nigris.

Long. $5\frac{1}{4}$ lin., lat. $2\frac{1}{2}$ lin.

Semitransparent; body shining, and, when fresh, of a beautiful bright flesh tint, both above and below; after being kept

North American species, are examples of this. On the other hand, in others, as in the present species, the tooth appears distinctly to form part of the mentum, although it thins off and becomes semitransparent at the edges, the harder texture running up its middle continuously from the rest of the mentum. The truth is, that there are several forms of the mentum among the species which at present are ranked in this genus, and it should probably be broken up into two or three sections. In that case, the present and the following species would fall under different heads.

some time it loses its colour, and fades into a clear ferruginous-testaceous or pale fawn-colour. The antennæ have the first three joints, the base of the fourth, and the tip of the last of the same colour and semitransparency, the remainder deep black, opaque, and pubescent; the first three joints are slender and nearly cylindrical; the fourth increases in breadth as far as the ferruginous colour extends, it then suddenly becomes straight and compressed, and the two sides run parallel to each other; the remaining joints are in like manner compressed, and the sides parallel; they increase in breadth very slightly and gradually, but the slender joints at the base, compared with the broader 4-11, give the antennæ a decidedly claviform appearance; a groove runs up the middle on each side of the flat joints; the two last joints of the maxillary palpi and the apex of the mandibles are a little deeper in colour than the rest of the body. The head is smooth, with a very slight depression on each side in front. Clypeus rather projecting. Labrum moderate, broader than long, straight in front. Mentum without a middle tooth. Thorax with sides strongly reflexed, and with a dorsal channel and some slight wrinkles across the disk; the production of the posterior margin in the middle not so prominent as in some species. Elytra very convex and swollen, having much the form of the elytra in *Lia*, smooth and shining, and with nine rows of slender striæ, besides the commencement of a short sutural stria at the base, all slightly but distinctly punctate; interstices impunctate, but with two large and deep impressions on the inner side of the third stria, the one a little more than a fourth of the length of the elytra from the base, and the other about a similar distance from the apex, and near the margin a row of round impressions running along the interstice between the eighth and ninth striæ, and one opposite the end of the third stria, each impression having a raised point in the centre; the apex of the elytra is broadly truncate, the truncation sinuate. From the semitransparency of the elytra, the impression of the folding of the wings below is seen, giving the appearance of something like a device on the elytra, but in reality they are concolorous. The scutellum is elongate-triangular; the under side is smooth and shining; the legs a little darker in colour than the body, with the apex of the thighs, the apex of the tibiæ and the whole of the tarsi black or piceous black; penultimate joint of tarsi deeply lobed; claws pectinate.

The much-swollen elytra and the almost claviform antennæ of this species at first induced me to think that it might properly be made the type of a new genus; but as in all other respects it agrees with *Lebia*, as at present defined—unless perhaps that the terminal joint of the palpi is almost ovular, while in *Lebia*

it is truncate, I have not been able to justify to myself such a separation, these being points on which we find gradations existing in a greater or less degree among the different species of *Lebia*.

Pericalidæ.

RHAPHIDOGNATHA, mihi (*ῥαφὶς* and *γνάθος*).

Corpus depressum. Thorax postice obtuse-truncatum. Mandibulæ projectantes. Labrum porrectum. Maxillæ apice subuliformes. Antennæ breves, filiformes, leviter compressæ, articulo secundo vix tertio brevior. Mentum sine dente medio. Paraglossæ ad ligulam junctæ. Oculi prominentes. Tarsi articulo quarto simplici. Ungues non pectinati. Elytra basi quadrata, vix thorace latiora, lateribus parallelis.

1. *R. trimaculata*, mihi. Pl. XII. fig. 2.

Brunnea, nitida; clytris striatis, striis leviter punctatis, singulis macula testacea basali, conjunctis macula testacea apicali communi.

Long. $3\frac{1}{4}$ –4 lin., lat. $1\frac{1}{2}$ lin. •

Flattish and depressed. Chestnut-brown, shining; base of antennæ, mandibles and other parts of the mouth, margins of thorax and elytra, tibiæ and tarsi, somewhat paler; clypeus large and smooth; labrum smooth and projecting, emarginate, fringed with hairs; upper side of mandibles longitudinally striated alongside of labrum. Head deeply and longitudinally wrinkled on each side in front; vertex also somewhat wrinkled; not wrinkled behind the eyes. Antennæ not so long as head and thorax; all the joints very nearly of the same length, except the second, which is a little, but not much, shorter than the others; also all nearly of the same thickness, except the first, which is a little thicker; the fourth and following joints are slightly compressed; and, viewed on the flat side, the antennæ appear slightly thickest about the middle. Thorax transverse, rounded on the sides, widest a little before the middle, narrowest behind; anterior angles prominent and rounded; posterior angles obtuse, except at the extremity, which is very slightly excised on the exterior side; the base is obtusely truncate; margins broadly reflexed, most so behind, and rugosely punctate; a slight, narrow, but distinct dorsal line, not reaching to the anterior margin, but stopping at the anterior circular depression. Elytra flat, about three times the length of the thorax, and a little broader than it; base straight, and sides nearly parallel, widening very slightly before the apex, which is sinuate-trun-

cate; punctate-striate, the punctures on the striæ small and feeble; interstices impunctate, but appearing somewhat silky from excessively fine transverse strigations, which are only visible under a powerful lens; the striæ are eight in number, besides the short scutellar stria and the marginal stria; the latter is irregularly interspersed with deep, large punctures; there are two large punctures in the interstice between the second and third striæ, the one about a third from the base, and the other almost at the very apex. A large testaceous patch occurs at the base of each elytron, stretching obliquely from the shoulder towards the suture, not quite reaching the first stria; a third testaceous patch near the apex common to both elytra, reaching to the fourth stria. The upper side of the last abdominal segment has a number of distinct punctures on it. Under side same colour as upper, centre rather paler. Legs slight, moderate in length; the tarsi slender, fourth joint simple (not bilobed); claws not pectinate.

NYCTEIS, Casteln.

Under this and the following genus (*Belonognatha*, Chaud.) I include all those insects which have the characters of *Coprododera*, excepting that the mentum has not a middle tooth. Castelnau and Chaudoir have added other characters to the diagnosis of their respective genera, which would exclude from them the species which I am going to describe under each; but as these characters are not of essential value, I consider I do rightly in retrenching them, and thus opening the genera for the reception of species which agree with them in all essential points. For instance, the only particulars in which the species which follows (*N. Championi*) differs from the diagnosis of Castelnau is—1. that in his genus the last joint of the palpi is said to be "obtuse at the end," while mine is "subacuminate," a difference which may perhaps principally lie in the mode of expression; and 2. that in his the external and sutural angles at the apex of the elytra are more or less spined, while mine, although toothed at the external angle, are not spined.

The distinctions between this genus and *Belonognatha*, as the characters are now adjusted by me, are the greater projection of the mandibles and greater convexity of the body in the latter, which has also the external angles of the apex of the elytra rounded instead of toothed; but this is a character which I do not think of generic value. Indeed, I am by no means satisfied that it would not be better to unite the two genera, and only use the above distinctive characters for sectional subdivision. If we were to adopt this course, and treat characters of similar value

in the same way throughout the group, it would be much simplified. We should then throw *Agonocheila*, *Stenoglossa* and *Coptodera* together, characterized as *Coptodera* with a middle tooth to the mentum, and *Nycteis* and *Belonognatha* together as *Coptodera* without a middle tooth,—the former almost exclusively inhabiting South America, the latter exclusively Africa (reckoning Madagascar as part of Africa). Indeed, I am strongly inclined to believe that the mistake I have already referred to as having been committed in the genus *Lebia*, of confounding the central base of the ligula with the middle tooth of the mentum, has been repeated here; and that if these parts were more carefully examined, it would be found that the species having a true tooth to the mentum are confined to America, while those without the tooth are restricted to the Old World. I do not think that the structure of these parts has been sufficiently minutely attended to by those authors who have described species of *Coptodera* as inhabiting the East Indies and Africa. There are six species described from each, and if these are analysed, there seems very insufficient evidence for holding that they are furnished with a tooth to the mentum. Of the six Eastern species, one is described by Dejean, four by Schmidt-Goebel, and one by Hope. As to Dejean's species (*C. gilvipes*), we may put it out of view, because he takes no notice of the mentum, and he himself says, "Je ne suis pas bien certain que cette espèce appartienne à ce genre." Of Schmidt-Goebel's species I have only had the opportunity of examining one (*C. flexuosa*), and I find that it most certainly has no tooth to the mentum; and if this mistake has happened to one of his species, it is none the less likely to have been repeated in the others. I have also examined Hope's *C. bicincta*, and there the same mistake or oversight has occurred. The so-called six African species are described, one by Dejean, four by Boheman, and one by Chaudoir. As Dejean habitually disregards the form of the mentum, his placing his species (*C. crucifera*) in the genus *Coptodera* goes for nothing, either one way or the other. As to Prof. Boheman, he says nothing about the mentum either; and he may either have overlooked it altogether, or fallen into the same error as Schmidt-Goebel and Hope. I have not seen any of his species, but the system of coloration and general description shows a great resemblance to my Old Calabar species, *Nycteis Championi* and *Belonognatha rugiceps*. There only remains the *figurata* of Chaudoir, and although it is not likely that he has overlooked the mentum (as he was fully alive to its importance), still it is not impossible that he may have fallen into the error regarding it of which I have been speaking. In my specimens of *Nycteis* from Old Calabar, the central base of the ligula between the roots of the

palpi forms a sort of triangular raised space, which on a cursory view might easily be mistaken for a tooth in the middle of the mentum, although more careful examination under a sufficiently high power shows that it may be separated from it, and, in point of fact, does not belong to it at all; so that it is not difficult to see how authors even of such standing and acknowledged accuracy as those referred to, should have fallen into this misconception.

1. *N. Championi*, mihi.

Parum depressus, nitidus, fuscus vel piceus; ore, antennis, thoracis lateribus, elytrorum marginibus, macula basali et fascia irregulari apicali atque pedibus, testaceis; capite fere lævi, mandibulis non valde prominentibus; thorace late marginato; elytris striato-punctatis, interstitiis convexis et impunctatis, apice oblique truncato et exciso, angulo exteriore apicali acuto; unguiculis pectinatis.

Long. 4 lin., lat. $1\frac{1}{2}$ lin.

Slightly depressed, shining, brown, with the mouth and antennæ, the margins of the thorax and elytra, a patch towards the base and a jagged irregular band towards the apex of the latter, and also the legs, testaceous. Head equally broad in front and behind, nearly smooth, with some faint wrinkles upon it, and two considerable depressions on each side, one on the inside of the eye, and the other larger before it; clypeus transverse, depressed in front; labrum rather broad, and not tapering, rounded at the anterior angles, slightly emarginate, and with a shallow longitudinal groove in the middle in front; mandibles slightly rounded exteriorly, not much projecting; antennæ darker towards the apex, slightly flattened and thickened from the end of the fourth joint to the apex; eyes large and prominent. Thorax broad, short, transverse, and somewhat cordiform, with very broad, shallow, semitransparent, reflexed margins, marked in the bottom with faint transverse depressions or foveæ; disk slightly convex, with a longitudinal dorsal line reaching from the front to the base, and a semicircular impression in front; faintly marked with transverse wrinkles; posterior angles somewhat obtuse. Scutellum impunctate. Elytra broader than thorax, slightly expanded posteriorly, punctate-striate, interstices convex and impunctate; a fovea on the second stria near the apex, another about a third of the length of the elytra from the apex, and another on the third stria, about the same distance from the base; the exterior interstice with a series of round flat-bottomed foveæ; margin inflexed, both the inflexed portion and the raised edge of margin testaceous; an oblique irregular

testaceous patch near the base of each elytron, on the fifth, fourth, third, second, and part of the first interstices, parallel to the side of the scutellum, though at some distance from it; the mark on the third interstice reaches farthest back, that on the fourth farthest forward; an irregular, jagged, testaceous band near the apex also runs across the whole elytra, but indistinct at the suture and on the exterior interstice; the space on the first two interstices reaching nearest to the apex, the two next farthest from it, and the three last again approaching it. The apex is obliquely truncate and excised, the exterior angle sharp, the sutural angle prominent, but scarcely toothed; the last segment of the abdomen punctate on the upper surface; under side of body smooth, shining, impunctate. Legs slender; tarsi simple; claws pectinate.

I have named this species in memory of my lamented friend Col. Champion, who fell at Inkermann, a naturalist whose loss will be long felt.

BELONOGNATHA, De Chaud.

As mentioned under the last genus, I have slightly relaxed Chaudoir's characters to allow admission to the following species. He describes the labrum as "very long, canaliculated at its extremity, strongly rounded and emarginate in the middle." I retrench the latter half of these characters. In my species the labrum is "very long and canaliculated at its extremity," but it is not "strongly rounded and emarginate in the middle." The only other character in which mine differs is, that he gives as a character that the anterior tibiae are furnished with a single terminal spine, the intermediate and the posterior with the two usual spines, and that the third and fourth joints of the anterior tarsi are subcordiform. In my species the external spine of the anterior tibiae is small, but still is not wanting, and the joints of the anterior tarsi are not subcordiform. In all other respects the characters agree.

1. *B. rugiceps*, mihi.

Parum convexa, nitida, picea; capite creberrime rugoso; thorace late marginato, marginibus reflexis et testaceis; elytris piceo-virescentibus, striato-punctatis, interstitiis convexis, apice oblique-truncato, fortiter sinuato, marginibus testaceis, singulis macula basali irregulari, et fascia interrupta apicali testaceis ornatis; antennis, ore, pedibusque testaceis.

Long. 4 lin., lat. 1½ lin.

In coloration and general appearance very similar to *Nycteis Championi*; slightly convex, piceous; the elytra fuscous, with a

slight virescent reflexion in certain lights, each with an irregular basal patch and an interrupted apical fascia testaceous. The antennæ, the parts of the mouth, the margins of the thorax and elytra, and the legs pale ferruginous. Head dark brown or piceous, about the same breadth before as behind the eyes, upper surface exceedingly densely and pretty deeply corrugated all over, so much so as to appear almost opaque; clypeus transverse, narrowest in front, wrinkled, separated from front by a marked straight line; labrum about the same length as the clypeus, narrowest in front, truncate, with a longitudinal groove in the middle in front, and a puncture on the margin near the apex; mandibles sharp and projecting, but not so much so as in the next species; terminal joint of palpi subcylindric and subacuminatè. Antennæ about the length of head and thorax, the end of the fourth, the fifth and remaining joints flattened. Eyes very large. Thorax considerably broader than head, cordiform, gently convex in the middle, and with very broad and deeply reflexed margins, which have here and there a few large punctures scattered in the bottom of the hollow; the disk very faintly wrinkled across, and with a dorsal longitudinal stria, fuscous, but paler than head, in some lights faintly virescent; margins semitransparent and broadly testaceous; posterior angles nearly right-angled; base truncate. Scutellum testaceofuscous, impunctate. Elytra shining, broader than thorax, but not twice as broad, somewhat convex; base nearly straight; sides very slightly expanded; pitchy-black when looked at from in front backwards, virescent when looked at from behind forwards, deeply punctate-striate; eight striæ, besides scutellar and marginal striæ; the interstices convex and apparently impunctate; but with a very powerful lens, a few punctures of the faintest description may be traced, disposed in a row along each interstice; a fovea on the inner side of the second interstice near the apex, and another about one-third from it; another on the third stria about the same distance from the base; a series of round, flat-bottomed foveæ on the marginal interstice; apex obliquely truncate and excised, the exterior apical angle flattened and rounded; the seventh stria sweeps round at the apex, enclosing those nearer the suture; margin inflexed, inflexed portion and raised edge of margin testaceous; a transverse testaceous patch about one-fourth from the base is disposed as a series of longitudinal stripes occupying five interstices between the striæ as follows:—the longest stripe on the space between the third and fourth striæ, the second longest between the second and third, the shortest between the fourth and fifth, and the remaining two, on the spaces between the fifth and seventh striæ, are next shortest, and of about equal length; a transverse, interrupted,

testaceous fascia runs irregularly across near the apex thus :—a short stripe near the apex on the space between the first and second striæ ; one, a little longer, extends farther towards the apex on the next space ; another, about the same length, occupies the next space, extending towards the base from the anterior part of the last ; the next lies alongside of it, but is not quite so long ; three short ones, each successively becoming smaller, start from the posterior corner of the last, and stretch across to the margin. Upper side of last segment of abdomen smooth and sparingly punctate. Under side shining, impunctate, piceous, paler in the middle ; breast, mouth and legs testaceous ; claws pectinate.

2. *B. obesa*, mihi.

Convexa, nitida, supra fusco-viridis ; thorace late marginato ; clytris quatuor maculis testaceis irregularibus ornatis, punctato-striatis, interstitiis elevatis et convexis.
Long. 6 lin., lat. 2½ lin.

Convex, shining, above green, or brown with green reflections ; clytra, when looked at from in front, brown (except at the very base), when from behind, green ; each with two testaceous marks of irregular shape on the disk, one about a third of the length of the clytra from the base, the other about the same distance from the apex ; below brown, with legs ferruginous. Head above green, rather depressed ; eyes prominent, space next the eyes irregularly rugose, inclination of rugosity longitudinal ; vertex rather elongate, smooth ; clypeus quadrangular, narrower in front, brown ; labrum brown, long, narrower in front, margins very slightly reflexed, emarginate in front, and with a slight groove in the middle for a short space, and an indentation on each margin near the front. Mandibles brown, long, fine, sharp-pointed, and projecting almost immediately straight from the eyes, so that the head has a very long narrow triangular muzzle ; other parts of the mouth pale ferruginous ; palpi filiform ; ligula very prominent ; paraglossæ attached to it, and embracing it, but not quite meeting in front ; mentum without a middle tooth. Antennæ a little longer than head and thorax, brown, three first joints paler, first joint most robust, second joint shortest, remainder nearly of equal length and thickness, but, if anything, each becoming a very little longer and thicker than the preceding. Thorax cordiform, bronzy-green, with the edges semitranslucent and semitestaceous ; margins broadly reflexed, most so at the posterior angles, which are obtuse ; base truncate, straight in the middle, sloping obtusely to the posterior angles, a broad margin intervening between the base and disk ; anterior angles projecting and rounded ; dorsal channel and

rounded groove in front distinct; disk convex, impunctate, with transverse wrinkles across it. Scutellum black, impunctate, with two depressions at its base. Elytra very convex, nearly twice as broad as the thorax, gradually expanding behind till they reach about a third from the apex, when they round in, and become sinuate and obliquely truncate; they are deeply punctate-striate, the punctures on the striae small and close to each other; the striae (with the exception of the two next the suture) do not reach the base, a narrow smooth space intervening; the interstices between the striae are ridged, convex, shining, and appear impunctate when viewed by the naked eye or a weak lens; when viewed with a more powerful lens, a row of very minute punctures is seen on the top of each interstice; towards the margin these punctures become more frequent and irregular; one or two foveæ occur on some of the striae, but they are not constant; the most constant seem to be one on the third stria very near the base, and two on the second stria, one quite at the apex, the other near it; a series of large circular foveæ occurs on the exterior interstice. The anterior testaceous blotch runs in a narrow line across the second, third, fourth and fifth interstices (not reckoning the space between the first stria and the suture as an interstice), and on the third interstice becomes nearly twice as broad, extending itself both up and down; the posterior testaceous mark is arranged transversely, somewhat checker-wise, as follows:—a small spot on the first interstice not far from the apex; another on the second interstice, a little larger, joining the posterior external angle of the first; another rather larger transverse spot on the third and fourth interstices commences at the anterior external angle of the second; and another transverse spot, of the same size as the last, on the fifth and sixth interstices, commences at the posterior external angle of the fourth. The terminal segment of the abdomen projects prominently; it is truncate; the centre alone is of solid texture, black, sparingly punctate, with a slight ridge in the middle. Underside dark brown, polished and impunctate, except the metasternum, which has its exterior margins slightly punctate. Legs ferruginous; anterior tibiae emarginate; all the tibiae with both internal and external spines at the apex. Claws pectinate.

3. *B. quadrinotata*, mihi. Pl. XII. fig. 3.

Præcedenti valde affinis, sed minor; thorace minus marginato; elytrorum maculis minoribus.

Long. $4\frac{1}{4}$ lin., lat. $2\frac{1}{4}$ lin.

Exceedingly like *B. obesa*, but smaller. The same description will answer for it, with the following differences:—The thorax is

comparatively smaller, and not so broadly margined, and the anterior rounded angles are rather less prominent. The testaceous spots on the elytra are much smaller, being limited to small points; the basal spot scarcely extends beyond the third interstice, although, on close examination, it is seen to encroach a little on each of the adjoining interstices, and the apical spot is almost confined to the third and fourth interstices.

This may be merely a variety of the preceding. If there had been nothing to distinguish them but the markings on the elytra, I should never have thought of separating them; but the less-margined thorax induces me to keep them separate, at least until a larger series of specimens shall enable us to come to a different conclusion.

THYREOPTERUS, Dej.

1. *T. flavosignatus*, Dej. 5. 446.

Nigro-piceus, subpubescens; thorace quadrato; elytris tenuistriatis, punctatis, singulis macula basali sinuata, conjunctis macula apicali sinuata communi, femoribusque flavis.

Long. $4-4\frac{1}{2}$ lin., lat. $2-2\frac{1}{2}$ lin.

CATASCOPUS, Kirby.

1. *C. Senegalensis*, Dej. 5. 453.

Supra capite thoraceque viridibus; elytris viridi-cyaneis, profunde striato-punctatis, interstitiis subæqualibus, margine laterali viridi; pectore, abdomine pedibusque piceis.

Long. 5 lin., lat. $1\frac{3}{4}$ lin.

2. *C. Beauvoisii*, Casteln. Et. Ent. 60.

Statura et colore *C. Senegalensi* simillimus, parum grandior et latior; elytris viridibus vix viridi-cyaneis, margine laterali viridi-cupreo; subtus niger, leviter virescens; pedibus piceis, femoribus ferrugineis.

Long. 7 lin., lat. $2\frac{1}{2}$ lin.

3. *C. rufipes*, Gory, Ann. Soc. Ent. Fr. ii. 204.

Supra viridi-cyaneus, margine elytrorum concolore, capite et thorace leviter rugosis; subtus piceus, pedibus rufis.

Long. $4\frac{1}{2}$ lin., lat. $1\frac{1}{2}$ lin.

Var. *rugifrons*, mihi.

Supra cupreo-viridis, capite crebre aciculato, thorace sat fortiter transverse aciculato.

Long. $4\frac{1}{4}$ lin., lat. $1\frac{1}{2}$ lin.

The following are the points in which this variety differs from the typical specimens :—

The head, instead of being almost smooth in the middle and towards the back, and only faintly furrowed on the sides, is covered closely all over with distinct fine wrinkles, mostly longitudinal, with a few punctures scattered among them behind. The thorax also is much more coarsely transversely wrinkled, and the colour is yellowish-green instead of bluish-green.

I have not thought these distinctions sufficient to constitute this a different species, but they are sufficiently well marked to justify me in noting it as a variety.

4. *C. compressus*, mihi.

Depressus, supra viridi-æneus, nitidus; capite antice, antennis pedibusque brunneis; thorace angulato; clytris viridibus leviter æneo-marginatis, fortiter striatis; subtus brunneus vel nigro-piceus.

Long. $2\frac{1}{2}$ –3 lin., lat. $1\frac{1}{2}$ lin.

Smaller, flatter, and more depressed than any species of *Catascopus* yet described; having the compressed form of an insect living under bark; shining, above brassy-green; the elytra greenest, the thorax less so, the head only with a faint reflexion of green on the back part; the rest of the body blackish-brown or piceous. The labrum much produced, opaque; the clypeus shining, very slightly emarginate in front, with a fovea on each side. Head slightly rugose on the sides, with an oblique depression inclined towards the vertex; behind smooth. Antennæ brown, first joint paler. Thorax somewhat convex, smooth and impunctate, with a deep dorsal line, the sides and base slightly reflexed and margined; the base obtusely truncate; the posterior angles excised, so as to be nearly right-angled; after leaving the excision which forms the right angle at the base, the sides widen out gradually till about a third from the front, where they form a pretty sharp prominent angle*, and then gradually become narrower till they reach the anterior angles, which are rounded; the slight projection or angle alluded to, causes the sides of the thorax, instead of appearing rounded, to appear as if an-

* This is a character peculiar to all the true *Catascopi* which I have seen.

gular; there is a fovea at the base on each side of the dorsal line, about midway between it and the angle; the reflexed margin at the base is broader than at the sides; there is a slight tendency to transverse wrinkling across the disk, more particularly behind. Scutellum black and opaque, and scarcely reaching beyond the interspace between the thorax and elytra. Elytra rather broader than thorax, with base nearly straight, but sloping slightly from the shoulders (which are rather prominent) inwards to the scutellum; their sides are nearly parallel; they are shining, greenish, with a tinge of brassy on the margins, becoming slightly coppery at the very apex, deeply striate, and with faint indications of punctures at the bottom of the striæ; the interstices impunctate, but under a powerful lens they show fine transverse strigations, which give them a somewhat silky appearance. There are eight striæ, besides the scutellar stria and the outer marginal one, which, with that next it, is the deepest. A number of deep punctures or foveæ occur on the marginal stria, or on the interstice between it and the next one. A deep puncture also occurs on the inner side of the third stria, not quite half-way from the base, and another on the outer side of the second stria, almost at the apex. The apex is sinuate-truncate. The upper side of the last abdominal segment is silky-opaque, with a number of distinct punctures. Under-side and legs shining brownish-black, or piceous, impunctate. Legs moderate in length and slender; tarsi slender, fourth joint simple; claws not pectinate.

Errata in February Number.

After *Cincindela cincta*, Fab., p. 156, add—

5. *C. interstincta*, Schön., Dej. 1. 42.

Supra fusco-ænea, elytrorum puncto baseos, fasciis tribus interruptis, lineolaque apicis albidis.

Long. $7\frac{1}{2}$ lin., lat. $2\frac{1}{4}$ lin.

For *Drypta pectoralis*, p. 157, read—

Dendrocellus pectoralis (the claws of the tarsi being pectinated).

XXIV.—*New Species of Bulimus from India, Burma, and the Mauritius.* Described by W. H. BENSON, Esq.

Bulimus Domina, B., n. s.

Testa sinistrorsa, rimato-perforata, ovato-cylindrica, oblique striatula, albida, strigis obliquis, rufo-corneis picta; spira cylindrica, superne celeriter attenuata, apice acutiusculo; sutura impressa; anfractibus 8 convexiusculis, ultimo $\frac{3}{4}$ testæ vix æquante, basi rotundata; apertura vix obliqua, semiovali; peristomate undique expanso, marginibus conniventibus, callo brevi junctis, sinistro superne arcuato, columellari dilatato.

Long. 23, diam. 9 mill.; long. apert. 9, lat. 6 mill.

Hab. in regione Cashmiriana.

This species, collected by Lady Gomm, is an important addition to the sinistral group inhabiting the Western Himalaya, and consisting of *B. Kunawurensis*, Hutton, *Nivicola*, B., *arcuatus* and *Vibex*, Hutton, &c. Another conspicuous *Bulimus* of the same type, *B. candelaris*, Pfr., had been previously sent to me from the same region, and Dr. Thomson also met with it at Tukhti Suleimán. The habitat was unknown to Pfeiffer. Reeve conjectured that it was from the confines of Europe and Asia.

Bulimus salsicola, B., n. s.

Testa rimata, ovato-cylindrica, tenui, sursum conica, læviuscula, oblique obsolete striatula, albida, maculis quibusdam translucen-
tibus obscuris notata; sutura impressiuscula; apice subpapillari, obtusiusculo; anfractibus $6\frac{1}{2}$ planiusculis, ultimo $\frac{1}{3}$ testæ super-
ante subtus prope rimam compressiusculo; apertura vix obliqua, truncato-ovata; peristomate plane reflexo, marginibus conniventibus, dextro arcuato, callo parietali brevissimo, crassiusculo, tuberculum obsoletum angularem exhibente, junctis.

Long. 18, diam. 8 mill.; long. apert. 8, diam. 6 mill.

Hab. in montibus salsiferis Pentepotamiæ Indicæ. Teste W. Theobald.

It is possible that this shell may exhibit coloured markings, like those of some other Punjab species, *B. pretiosus*, *Sindicus*, &c., when in finer condition. It has a strong resemblance in form to the larger *B. Bertheloti*, Pfr., and is also allied to the Levantine *B. Ehrenbergi* of the same author.

Bulimus Estellus, B., n. s.

Testa arcte perforata, oblonga, cylindrica, subremote spiraliter sulculosa, interstitiis confertissime costulato-striolatis, albida; spira cylindracea, apice conico, acutiusculo; sutura impressa; anfractibus 8 vix convexiusculis, ultimo antice ascendente, $\frac{1}{3}$ testæ parum

aequante, basi circa perforationem leviter compressa; apertura verticali, angulato-ovali; peristomate obtuso, margine columellari verticali incrassato-reflexo.

Long. 18, diam. 6 mill.

Hab. in regione Sindica. Teste Col. W. E. Baker.

At once distinguishable from the allied *B. Pullus*, Gray, by its stouter form, and by the ascent of the last whorl near the aperture.

Bulimus Pertica, B., n. s.

Testa imperforata, exacte cylindrica, elongatissima, confertissime arcuato-striolata, sulcis nonnullis inconspicuis spiraliter sculpta, alba; spira cylindrica, apice conico, obtusiusculo; sutura impressa; anfractibus 10 subplanulatis, ultimo $\frac{1}{2}$ testæ æquante, antice leviter descendente, basi rotundata; apertura valde obliqua, pyriformi; peristomate tenui, margine basali incrassato, subeffuso, columellari expanso, appresso.

Long. 20, diam. 5 mill.

Hab. in regione Sindica. Teste Col. W. E. Baker.

At once distinguishable from *B. Pullus*, Gray, and its allies by its lengthened cylindrical form, its slenderness, and by the obliquity of the aperture. I am indebted for this and the preceding species to Mr. S. P. Woodward, who received them from the discoverer.

Bulimus sanguineus, Barclay (MS.), n. s.

Testa vix perforata, ovato-pyramidata, nitente, oblique rugoso-striolata, striis exilissimis confertissimis spiralibus decussata, albida, infra præsertim roseo-tincta, strigis obliquis undatis purpureo-castaneis ornata; spira acuminato-conica, apice acutiusculo, nigro; sutura impressa; anfractibus $6\frac{1}{2}$, ultimo $\frac{1}{2}$ testæ vix æquante, ad periphæriam obsolete angulato; apertura vix obliqua, ovata, superne angulata; peristomate tenui, recto, acuto, marginibus callo tenui junctis, columellari superne breviter fornicatim reflexo, perforationem obtegente.

Long. 20, diam. 12 mill.; long. apert. 9, lat. 8 mill.

Hab. prope Reduit, in vallibus angustis pagi Moka, Insulæ Mauritii. Detexit Sir D. W. Barclay.

This beautiful shell, conspicuous from the contrast of colours, forms a fine addition to the Mauritian fauna.

Bulimus Physalis, B., n. s.

Testa subobtectæ perforata, ovato-conica, tenuiuscula, oblique striatula, albida, nitente; spira conica, apice obtusato; sutura leviter impressa; anfractibus $5\frac{1}{2}$ superne subplanatis, primis granulatis, cæteris striis spiralibus minutissimis decussatis, ultimo tumidius-

culo $\frac{1}{2}$ longitudinis æquante, ad periphæriam plerumque angulato; apertura ampla, obliqua, truncato-pyriformi; peristomate expanso, marginibus reflexis, callo tenui junctis, columellari superne latissimo, appresso, oblique leviter impresso, umbilicum angustum pervium fere tegente.

Long. 27-28, diam. 16-17 mill.; long. apert. 14-16, lat. 9-10 mill.

Hab. ad Khoonda Ghât, Montium Nilgherries, Indiæ Australis.

Teste T. Jerdon.

Well distinguished from the Cingalese species, *albizonatus*, Reeve, *Ceylanicus*, and *intermedius*, Pfr., by its ventricose form, the more ample aperture, and the mode of sculpture. A perfect specimen, in the Museum of the India House, and a young one received from Dr. Jerdon, have the periphery angulate; whereas an adult specimen communicated by Dr. Jerdon is deficient in this feature.

Bulimus pleurophorus, B., n. s.

Testa subperforata, ovato-pyramidata, costis verticalibus validis confertis, interstitiis nitentibus, munita, albida; spira elongato-conica, apice obtusulo, sutura profundiuscula; anfractibus $7\frac{1}{2}$ convexis, ultimo $\frac{1}{2}$ testæ æquante, ad basin rotundato; apertura subcirculâri; peristomate recto, acuto, margine columellari reflexiusculo, dextro arcuato.

Long. 8, diam. $3\frac{1}{2}$ mill.

Hab. rarissime ad Teria Ghât, Montium Khasia. Teste W. Theobald.

A single specimen of this shell (which, in form only, has relations to the maritime European *Bulimi*) has been submitted for inspection. It is not in a fresh state, and may possibly present a horn-coloured epidermis in a more perfect condition.

Bulimus Theobaldianus, B., n. s.

Testa obtecte perforata, ovato-conica, oblique striata, striis exilibus obsoletis decussata, ferrugineo-albida, superne fascia maculifera tæniata, maculisque obliquis elongato-quadratis distantibus, subtus fasciis duabus castaneis, alteraque unica periphærica albida ornata; spira conica, apice nigro, obtusiusculo; sutura leviter impressa; anfractibus 5 vix convexiusculis, ultimo medio obtuse funiculato-carinato, dimidium testæ vix æquante; apertura vix obliqua, truncato-ovata; peristomate tenui? recto? margine columellari verticali lilacino, tota longitudine anguste fornicatim reflexo, perforationem fere tegente; periomphalo translucente, pallide corneo.

Long. 15, diam. 9 mill.

Hab. raro ad Yanglaw, Tenasserim. Teste W. Theobald.

The mouth of the specimen received is defective in the right lip. The disposition of the painting has a singular resemblance to that of the Philippine *B. zonulatus*, Pfr.

The above description exhibits too many points of disagreement to allow of the shell being supposed to represent Gould's (mostly sinistrorse) *B. monilifer*, notwithstanding the similar distribution of markings, and the subcarinate last whorl, noted by Gould, but not observable in Reeve's Bornean shell, *B. Adamsii*, which Pfeiffer, in accordance with Gould's announcement to Reeve, assigns as a synonym to *B. monilifer*. That shell belongs to the group of *B. perversus*, while *B. Theobaldianus* is allied to *B. Bengalensis*, Lamarck, and to *B. zonulatus*. The interior of the aperture is coloured as vividly as the exterior. Just behind the aperture there is a tendency to the formation of square spots between the two chestnut basal bands. The direction of these spots is also oblique, but at an angle to that of the row above the periphery.

Mr. Theobald found no shell in Tenasscrim which can be referred to *B. monilifer*. The nearest approach to it occurs in a large species, 41 millimètres in length, received by him as found to the southward of Mergui, and answering to the description of *B. Janus*, Pfr., of which New Hebrides is the received habitat. It is indifferently dextrorse or sinistrorse. *Bulimus perversus*, var. *atricollosus*, Gould, was common in the valley of the Tenasscrim River.

Bulimus Putus, B., n. s.

Testa perforata, ovato-acuta, tenui, striatula, sub epidermide tenui cornea albida; spira conica, apice obtusiusculo, sutura satis impressa; anfractibus 6 convexis, ultimo dimidium testæ vix superante; apertura verticali, semiovali majuscula; peristomate acuto, recto, margine columellari reflexiusculo.

Long. 7, diam. vix 5 mill.; long. apert. vix 4, diam. 2½ mill.

Hab. ad Tavoy. Teste W. Theobald.

Peculiar in form. The only specimen examined is in a worn state.

A small *Bulimus* of the "*Pullus*" type, twelve millimètres in length, and which appears to differ in nothing but size from *B. Agrensis*, Kurr (Malakoz. Bl. 1855, and Nov. Conch. t. 16. f. 9, 10) was collected by Mr. Oldham in Ava, thirty miles above the British frontier. Kurr's specimen in the Munich Museum is stated to have been found at Agra in Upper India.

Cannes, February 19th, 1857.

XXV.—On the *Anatomy of the Rhinanthaceæ*, considered in its relations with the classification of these plants. By A. CHATIN*.

It can no longer be doubted that Anatomy can and must intervene in Botany, as it has long done in Zoology, to fix the position of orders, families, genera, and frequently even of species of plants in the natural system, and to complete their diagnosis. The researches which I have just completed upon the *Rhinanthaceæ*, an important family, the parasitism of which was not suspected before the interesting and unexpected observations of M. Decaisne †, bring in support of this opinion an amount of new facts, which, it seems to me, should attract the attention of those naturalists who take an interest in the means of perfecting the natural system, and especially that of those who occupy themselves with descriptive Botany.

As essential anatomical characters of the order *Rhinanthaceæ*, I shall indicate in the stem, the vessels never entirely united into bundles, and the want of the fibro-cortical system, or at least of cortical prosenchyma exterior to the fibrous tissue properly so called; in the rhizome, the constant existence of the organ itself, always anatomically determinable, the absence of true spiral vessels, and the vessels never approximated in groups; in the leaves, the epidermic cells which are always chromuliferous, although furnished with numerous stomata, and the vessels generally neither prismatic nor pressed together.

The natural anatomical character is completed by the habitual absence of medullary rays in the rhizome, and of the fibro-cortical body in the stem, by the medullary sheath and proper woody stratum not being confused, by the leaves with the epidermic cells almost always with sinuous side-walls, and with the parenchyma homogeneous towards the two faces; and, lastly, by the presence of capitate glands of 1 to 4, rarely 8 cells, as in many true *Scrophulariaceæ*.

The *Rhinanthaceæ* have very great affinities with non-parasitic plants not belonging to the same family. However, to the morphological characters which distinguish them from the *Scrophulariaceæ*, and which appeared to the illustrious Laurent de Jussieu sufficient for their separation, we must add their parasitism, the constant absence of medullary rays in the stems, and that of the fibro-cortical bundles.

The families of parasitic plants with which the *Rhinanthaceæ* have the most analogies, both anatomical and morphological, are the *Epipirhizanthaceæ*, the *Orobanchææ*, and the *Monotropææ*.

* Translated from the *Comptes Rendus de l'Académie des Sciences de Paris*, 2nd March, 1857, p. 470.

† *Comptes Rendus*, 12th July, 1847.

Related to the *Orobanchæ* by their rhizome with wide medullary communications, by their epidermis with subhexagonal cells containing oleo-resinous drops, by their squamiform leaves with a homogeneous parenchyma, and the vessels crowded into a bundle in the axis of the nervures, the *Epirhizanthaceæ* approach very closely to the *Rhinanthaceæ* by the similarity of the vessels and fibres in the stem and rhizome.

To the morphological differences, considerable as they are, which separate the *Rhinanthaceæ* from the *Orobanchæ*, we have to add some anatomical facts, which acquire great value from their constancy and general occurrence: such are the rhizome, constantly destitute of medullary rays, and with its vessels never grouped; the stem with a scattered vascular system and a distinct medullary sheath; the leaves with numerous stomata, with green matter, with the parenchyma sometimes heterogeneous, and the vessels distinct from one another.

The *Orobanchæ* have numerous morphological affinities with the *Rhinanthaceæ*, which would be sought for in vain between them and the *Monotropeæ*; but nevertheless it is with the latter, which, like them, are more completely parasitic than the *Rhinanthaceæ*, that they present the greatest number of anatomical relations; so true is it that the structure of organized beings stands in necessary relations with their mode of life.

Each of the genera of the *Rhinanthaceæ* has its anatomical, as well as its floral characters. *Castilleja*, like *Obolaria*, has the medullary sheath scarcely, if at all, distinct; but its stem is provided with a fibro-cortical ring, and often with feculiferous fibre-cells. *Schalbea* differs from *Castilleja* by its vessels arranged in radiating lines in the stem, and by its irregularly folded epidernic cells. The *Bartsia* are destitute of the fibro-cortical system, and have the medullary sheath distinct. *Odontites* and *Euphrasia*, which have but little morphological distinction, are confounded by their anatomy. *Cymbaria* is well characterized by its vessels being frequently approximated by twos and threes in the rhizome, and all placed in radiating lines in the stem, by its fibro-cortical layer, and by its thick pitted fibres which enter into the bundles of the leaves. *Rhynchosorys*, recently separated from *Rhinanthus* by the morphologists, is a genus which is admitted by anatomy, as the spiral vessels of the sheath are not arranged upon the lines of the pitted rayed vessels of the woody layer, and as in the leaves the vessels are isolated from each other, at the same time that the parenchyma is homogeneous throughout its thickness. *Pedicularis*, a numerous genus, the species of which present considerable floral differences, exhibits no more uniformity in its anatomy than in its morphology. We may, however, regard as its general cha-

acters: the great development of the perforating cone and the existence of fibroid strengthening folds in the suckers; in the stem the constantly distinct medullary sheath and the pitted utricles of the pith; and in the leaves the thick pitted fibres, and the epidermis and parenchyma often heterogeneous. *Melampyrum* has the perforating cone of the suckers well organized, but destitute of strengthening folds, the medullary sheath not distinct from the concentric woody layer, and, by an exception to the character of the order, which occurs, however, also in *Rhinanthus*, it has the vessels of its leaves grouped as in the *Orobanchæ*, amongst which it corresponds exactly with *Phelipæa*. Lastly, *Tozzia*, which is morphologically very nearly allied to *Melampyrum*, is well distinguished therefrom by its leaves with the vessels neither pressed together nor prismatic, and the parenchyma homogeneous, as well as the epidermis, towards the two faces of the limb.

The anatomy, which is not favourable to the splitting of the genus *Bartsia* into *Eufragia* and *Trizago*, separates very distinctly some species which there is great difficulty in distinguishing morphologically. The *Odontites Jaubertiana*, which has been, until very recently, confounded with *O. rubra*, even at the gates of Paris, differs considerably from the latter in the structure of its leaves and medullary sheath. In the same way also the *Euphrasia paludosa* and *E. speciosa* of R. Brown, which the learned Bentham appears inclined to unite as simple varieties, must remain separated; the latter species differing greatly from the other by the form of its epidermic cells, which is rare even in the order.

With these examples I conclude, as I only wish to show here that botanists might have recourse to anatomy with good results, even in the determination of the value of critical species.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

June 24, 1856.—Dr. Gray, F.R.S., in the Chair.

ON THREE GENERA OF VESPERTILIONIDÆ, FURIPTERUS, NATALUS AND HYONYCTERIS, WITH THE DESCRIPTIONS OF TWO NEW SPECIES. BY ROBERT F. TOMES.

The genus *Furia* was established by M. F. Cuvier from the examination of a single example taken at Mona in South America, by M. Leschenault.

Linnaeus having previously made use of the name in another branch

of zoology, it has been proposed by Prince Charles Lucien Bonaparte to substitute that of *Furipterus*. The latter name will be here adopted, and as the opportunity of examining a second species has occurred, it will afford the means of confirming the generic characters given by the original describer, and also supply some additional peculiarities.

Genus FURIPTERUS, Bonap.

The top of the head is very much elevated, leaving a deep hollow between that and the end of the nose. The muzzle is very short, rather small, and abruptly truncated at the end. This gives the end of the nose something the appearance of that part in the genus *Sus*, and the similarity is increased by the superior margin being produced in an upward direction, as in that genus. The end of the snout may properly be called a disc, widest at its base, and having a slight emargination in the middle of its upper boundary. In this disc the nostrils are placed, small, directed straight forward, and nearly round. Between them is a narrow vertical groove, continuous from the emargination of the upper border of the disc.

All the face is densely covered with soft long hair, only the flat end of the nose and the extreme margins of the lips being naked. Near to the edges of the lips, and about the corners of the mouth, the fur assumes the aspect of a beard. Around the upper margin of the nose-disc is a fringe of fine short silky hairs.

The ears are rather large and broad, directed forward, and deeply concave within. Their inner margins project inwards and forwards over the forehead in the shape of a rounded lobe. Their extremities are rather acute and directed outwards.

The tragus is shaped somewhat like the head of an arrow, supported on a narrow foot-stalk. It is short and rather broad, with a descending barb or point on each side, the outer one being the longer and more acute. From these it tapers rapidly to a narrow, but rounded tip, directed a little outwards.

The most remarkable peculiarities in the organs of flight consist in the excessively small size of the thumb, and the shortness of the middle phalange of the longest finger. The thumb has the basal joint much longer than the terminal one. It is wholly engaged in the antebrachial membrane, the nail only being free. The phalange of the finger, above alluded to, has its length contained three and a half times in that of the terminal one, and six times in that of the basal one. The middle phalange of the third finger also is somewhat shorter than is usual in most *Vespertilionidæ*.

The wing-membranes extend to the distal end of the tibia. The legs are long and slender, and the heel cartilage very long. All the membranes are thickly marked with fine dotted lines, the interfemoral having not less than twenty-five. In this respect they bear considerable resemblance to those parts in *Rhinolophus* and *Nycteris*.

The cerebral part of the skull is excessively elevated, quite dome-shaped, and the facial portion very much depressed.

From the extraordinary elevation and expansion of the parietal bones, the frontal bone is reduced to unusually small dimensions.

Its posterior portion rises nearly at right angles from the termination of the nasal bones, is narrowly triangular, and ends in a point near the top of the elevated part of the cranium. Its anterior portion is nearly horizontal in position, and is deeply cleft in the middle by the nasal bones, which extend backwards as far as to the ascending part. What may therefore be called the facial part of this bone is divided into two forks, extending one on each side, between the nasal and maxillary bones. Each of these forks is somewhat swollen, and this, with a great depression along the line of union of the nasal bones, gives a deep longitudinal groove to the facial part of the cranium, which however becomes nearly obsolete at the nasal opening.

A great peculiarity consists in the development of the intermaxillary bones. These are not cleft in front as in *Vespertilio* (leaving only space enough for the incisors to be placed close to the canines, and in a line nearly continuous with them), but are united, leaving only two small incisive foramina in the anterior part of the palate. Also they differ materially from the same bones in the genus *Vespertilio*, in having the upper free margins, forming the walls of the nasal opening, continued without any diminution of their depth to their most anterior point. The upper margins of these bones are usually very much sloped in the genus *Vespertilio*.

In consequence of the great degree of development of the intermaxillary bones, abundant space is allowed for the incisor teeth. Accordingly there is a considerable interval on each side between them and the canines, and they are arranged, not in a line with the rest of the dental series, but *vertically* and in a regular curve across the extremities of the above-mentioned bones. There is however an interval in front, between the central ones, though not so considerable as the space contiguous to the canines.

Their form is that of a short cone, the inner pair with their points directed somewhat inwards.

The canines are of a very remarkable form—a form, so far as I am aware, not hitherto observed in any other mammal. They present four points: a central cusp of the usual canine form, a lobe accessory to this, and situated about the middle of its posterior edge, one at the base of the same edge, and one of a very pointed form at its anterior base. The remaining teeth in the upper jaw do not differ materially from those of *Vespertilio* proper.

The lower incisors are uniformly arranged and bifid. The canines are small, with an anterior and posterior spur at their bases, the anterior one being the longer, and appearing like two additional incisors. There are three premolars on each side, conical, and increasing in size as they approach the true molars. These latter resemble those of *Vespertilio* restricted.

The formula of dentition may be thus expressed:—

$$\text{In. } \frac{2}{3} \frac{2}{3}, \text{ C. } \frac{1}{1} \frac{1}{1}, \text{ P.M. } \frac{2}{3} \frac{2}{3}, \text{ M. } \frac{2}{3} \frac{3}{3}, \text{ total } \frac{16}{30}.$$

On examining the under surface of the skull, we find that the bony palate does not extend posteriorly beyond the last molar. In this respect it resembles the genus *Miniopterus*, whilst in *Vespertilio* the

palate extends as far backwards as to the middle of the zygoma ; in *Vesp. (Kerivoula) picta*, nearly as far back as to the condyloid fossa.

The lower jaw has, at the lowest part of the symphysis menti, a prominent tubercle, directed downwards, and projecting below the level of the lower margin of the jaw. It is probable that this may be equivalent to the *spinæ mentales*. From this, the margin of the jaw curves very evenly and moderately to the *posterior angle*. The ramus is very high, and the *coronoid process*, the *condyle*, and the *posterior process*, are arranged in nearly the same horizontal line, the *condyle* being a little elevated above the other two. The *posterior process* has a peculiar outward direction.

Such are the characters derived from the examination of seven examples. They do not include some peculiarities mentioned by M. F. Cuvier, viz. the presence of a series of warts on the upper lip, and under the chin, the prominence of the eye, and the cartilaginous condition of the terminal half of the tail. I have failed to detect any warts, nor do I perceive that the eye is more prominent than in other *Vespertilionidæ*. As, however, I am describing from dried specimens, too great reliance cannot be placed on the apparent absence of these characters.

With respect to the tail, in the seven examples examined, five have it wholly withdrawn from the membrane, and the remaining two only partially withdrawn, the terminal vertebræ being left in the situation proper for the basal ones. This may possibly have been the case with the example mentioned by M. F. Cuvier, as suggested by Dr. Gray.

It may not be amiss to remark that this genus resembles the genus *Kerivoula* of Dr. Gray (as illustrated by *Kerivoula picta*) in the form of the ear, but in no other respect have I found them similar. The crania, although greatly elevated in both, differ in other respects, and even in this they by no means closely agree.

The genus *Miniopterus* approaches most nearly to *Furipterus*, in the characters exhibited by the cranium. They somewhat resemble each other in the elevated form of the vertex, in the length of the bony palate, and in some measure in the form of the posterior portion of the lower jaw, and the development of the intermaxillary bones.

1. FURIPTERUS HORRENS.

Furia horrens, F. Cuv. Mém. du Mus. xvi. p. 150. tab. 9 ; Fischer, Synop. Mam. Addenda, 352 ; Temm. Mon. ii. p. 264 ; Wagn. in Suppl. Schreb. Säuget. i. p. 549 ; Schinz. Synop. Mam. i. p. 207 ; Less. Nouv. Tab. Règ. Anim. p. 22.

The eyes prominent and large. The nostrils apical, and separated only by a margin surrounding them, forming a groove at their upper part. Lips entire, the upper one with four or five warts along its side. The lower lip has eight warts, conspicuous from being of a white colour, amidst the surrounding black fur. Ears large, nearly as broad as long, simple in structure. The tragus is of a peculiar form, having three points arranged like a cross.

The fur is soft and thick, except at the muzzle, where it is longer and coarser than that of the other parts.

The colour is a fine uniform black.

Length of the head and body (English) 1" 7^{'''}; expanse 6" 4¹/₂^{'''}.

Hab. S. America, Mona.

2. FURIPTERUS CÆRULESCENS, n. s.

Top of the head very much elevated, face depressed, excessively hairy, only the end of the nose and the extreme edges of the lips being naked. Ears as broad as high, roundish, with the tips angular and directed somewhat outwards. Tragus short, supported on a narrow foot-stalk, immediately above which is a descending process on each side. From these it tapers rapidly to a narrow, but rounded point, which is directed a little inwards. About the middle, between the tip and the inner descending process, is a slight angular projection.

The fur is everywhere long and silky. That of the upper parts is slaty-blue at its base, slightly tipped with dusky-brown, but not sufficiently so to appear bicoloured. On the head it is somewhat paler than on the back. The long fur of the face is darker and not quite so blue. The fur margining the lips is of a silky ash-colour. The chin is of a uniform grey-brown, the breast blue-grey, the fur tipped for a third of its length with whitish-grey. On the belly and pubal regions it is nearly uniform whitish-grey.

Of the specimens examined, two are males and the remainder females, and all are obviously adult. The sexes are similar.

The great similarity in the size of the examples renders it unnecessary for me to give the measurements of more than one. For the purpose of comparison I add the dimensions of the figure illustrating M. F. Cuvier's memoir.

	<i>F. horrens.</i>		<i>F. cærulescens.</i>	
Length of the head and body	1	6 ¹ / ₂ ^{'''}	1	3 ^{'''}
— of the tail	1	1 (?)		?
— of the head	0	0	0	6
— of the ears	0	4 ¹ / ₂ ^{'''}	0	3 ¹ / ₂ ^{'''}
— of the fore-arm	1	5	1	4
— of the longest finger	2	7	2	2
— of the fourth finger	1	7	1	9
— of the tibia	0	7	0	6 ¹ / ₂ ^{'''}
— of the foot	0	4	0	3 ¹ / ₂ ^{'''}
Expanse, following the bones, of the wings	9	3	8	9

Hab. St. Catharine, Brazil.

Genus NATALUS, Gray.

The forms of this genus bear considerable resemblance to those of *Furipterus*. The crown is very much elevated, and a deep depression separates it from the nose. The latter is broad, but not bulging at its sides, as observable in some *Vespertilionidæ* (such as *Scoto-*
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philus, Gray). The top of the nose, in front of the eyes, is rather prominent, and rounds down evenly on all sides to the edge of the upper lip, which if seen from below would describe a half-oval figure. The above-mentioned prominence is furnished with a central longitudinal ridge, terminating between the nostrils. These are apical, approximated, and of an ovoid form. They are placed so near the margin of the lip that they might almost be described as situated in it. They do not interfere with the curvature of the outline of that part, being simple perforations.

The lower lip is furnished with a broadish, naked reflexed edge, divided by a vertical groove in front. Below this is an irregular semicircular double row of warts, studded with bristly hairs, and a larger one beneath at the symphysis menti.

The ears are rather large, broadest at two-thirds of the distance from their bases. They are furnished with a descending free lobe at the base of the outer margin, which is unattached to the side of the face, somewhat like the *lobulus* of the human ear. Their extreme tips are directed outwards.

The tragus is of very peculiar form; it is supported on a distinct stalk, which springs horizontally from the inside of the auditory opening. From the extremity of this, the tragus rises vertically, and occupies the usual position in the ear. It is short, broad, and somewhat fleshy. The two margins curve to a rather acute tip, which is directed a little inwards. At the outer edge, towards the base, is a descending angular projection. About the middle of the ascending part, the tragus is twisted upon itself, in such a manner as to present only the *edge* of the upper part to the eye, whilst the basal portion presents its *flat* surface. From its tip spring a number of fine bristly hairs, straight and long.

The legs, feet, and os calcis are long, and the toes occupy about one-half of the length of the feet. The tail is very long, equal in length to the head and body; it consists of seven joints, the terminal one being small. The wing-membranes have a singular mode of attachment to the tibia. Viewing the animal from the under side they are seen to proceed from the base of the os calcis, in the form of a narrow rudiment of membrane, extending up the inside of the tibia for a fourth of its length. At this point they cross over the tibia, and pass outwards, forming the posterior margins of the wings. The thumb is rather small, but the wings do not present any other great peculiarities. All the membranes are thickly marked with dotted lines as in *Furipterus*, the interfemoral membrane having between twenty and thirty.

The upper incisors are four in number, in pairs, separated from the canines by an interval, and with a space in the middle between the pairs. They are small, of nearly uniform size, and obtusely conical. In the space between them is a prominent horse-shoe-shaped cartilage, a little in advance of them, being a prolongation of the anterior boundary of the palate. Behind this is a transverse prominent palatal ridge, divided in the middle by a notch.

NATALUS STRAMINEUS, Gray.

Natalus stramineus, Gray, Mag. Zool. & Bot. ii. p. 496; Cat. Mam. Brit. Mus. p. 28.

The face is very hairy, particularly along the median ridge, and on the upper lip, where it takes the form of a thick long moustache, extending the whole length of the lip. This rises on each side over the top of the nose, meeting in the middle, and forming a kind of transverse ridge of hair. Immediately in front of the eye is a naked space. The ears when held up to the light present a singular dotted appearance, and resemble in this respect the *Vesp. papillosus* of Temminck. The extreme tip of the tail is exerted.

The fur is of medium length and substance. On the upper parts, of a uniform brownish-yellow; on the under, the same but paler. The membranes and naked parts are reddish-brown.

The whole of the above has been taken, by the kind permission of Dr. Gray, from the two examples mentioned in his Catalogue, and the following are their dimensions. The first column refers to the specimen in spirit from South America, and the second to the one from St. Blas, North America.

	No. 1.		No. 2.	
Length of the head and body	" 1	" 9	" 1	" 11, about.
— of the tail	2	2	2	0, nearly.
— of the head	0	9	0	7½
— of the ears	0	5	0	4
— of the tragus	0	2	0	1½
Breadth of the ear	0	6	0	4½
Length of the fore-arm	1	5½	1	4½
— of the longest finger	3	0	2	9
— of the fourth finger	2	2	1	11
— of the thumb	0	2	0	2½
— of the tibia	0	9½	0	8
— of the foot	0	4	0	4
Expanse, following the bones, of the wings	10	6	10	0

Genus HYONYCTERIS, Licht. et Peters.

Incisors four above, in pairs, separated by a space in the middle, the apices bifid; below, six, contiguous, trifid. Canines, distinct, long, conical, surrounded by two rings or collars. Molars above and below, six on each side, the upper anterior ones separate, the three posterior ones close together and W-shaped. Tongue medium; snout elongated beyond the lips, with a discoid end (somewhat as in *Furipterus*). Nostrils below, *ensiform*. Lips tumid, the margins broadly reflected. Ears separate, broad, and furnished with tragus and antitragus. Wing-membranes broad, extending the whole length of the leg and foot, quite to the base of the nails. Interfemoral membrane entire, completely enclosing the tail, the last joint only of which is exerted. Thumb free, nailed, and with a broad suckorial disk attached to it. Index finger very short, scarcely a fourth as

long as the basal phalange of the longest finger; all the remaining fingers with three phalanges. The feet with five toes, furnished with a suctorial disc. All the toes composed of only two phalanges, and united by a web. Os calcis lobed and long.

1. *HYONYCTERIS DISCIFERA*, Licht. et Peters.

Hyonycteris discifera, Licht. et Peters, Neue merkw. Säugeth. 1855*.

The upper parts cinnamon-brown, beneath paler; wings dusky-brown.

Length of the head and body . . .	1	7
— of the tail	1	3
— of the head	0	7
— of the ears	0	5½
— of the tragus	0	2
— of the fore-arm	1	3½
— of the longest finger . . .	2	6
— of the fourth finger . . .	1	8½
— of the tibia	0	7
— of the foot and claws . .	0	3
Expanse of wings	8	3

Hab. Puerto Caballo, Central America.

2. *HYONYCTERIS ALBIVENTER*, n. s.

The specimen from which the present description has been taken has lost some of its parts by accident, and with them some of the peculiarities described by MM. Lichtenstein and Peters in the paper already alluded to. Thus, the tragus has been eaten away from each ear by insects, the nose-disc apparently so much rubbed as to have lost its original form, and the thumbs are entirely wanting. In other respects the specimen is in sufficient preservation to confirm the characters given by the above-mentioned authors, and also to furnish an additional peculiarity not given by them in their description of the genus. This will be hereafter indicated.

The crown of the head is very considerably elevated, the face very concave, and the muzzle rather elongated. The ears are scarcely as broad as high, the inner margin (towards the top of the ear) is very much rounded, and the extreme tip is conspicuously directed outwards. The outer margin is considerably hollowed out† for nearly the whole of its length, but with a rounded prominence at its base. The face is very hairy, and the upper lip has a distinct moustache of long hair.

* Gelesen in der Akademie der Wissenschaften, am. 22 Juni 1854. Berlin 1855.

† It appears desirable to state that the expression "hollowed out" must be taken in its literal sense, as the form here attempted to be described is very different from what is usually called "an emarginate ear," in the genus *Vesperugo*. In this genus it is a distinct "notch" in the outer margin of the ear: in *Hyonycteris* it is simply a shallow piece *scooped* out of the margin,—at least such is the case in the specimen I possess, but in the figure already referred to, this is less conspicuous.

On the whole of the upper parts the fur is of a reddish-brown colour, uniform in tint from its root to the tip. On the under parts it is pure white, tinged with rufous on the humeral region and on the chin.

This species appears to differ from the last in having the ear much more hollowed out externally, in being somewhat larger, and in having the under parts pure white.

Length of the head and body	2	0
— of the tail, about	1	2
— of the head	0	9
— of the ears	0	3 $\frac{3}{4}$ *
— of the fore-arm	1	5 $\frac{1}{2}$
— of the longest finger	2	6 $\frac{1}{2}$
— of the fourth finger	1	10
— of the tibia	0	8 $\frac{1}{2}$
— of the foot and claws	0	3
Expanse of wings, following the phalange .	10	6

Hab. River Napo, near Quito, where it was collected by Mr. Bates.

In addition to the generic characters given by the authors already quoted, the very peculiar form of the claws of the hinder feet may be mentioned. These are rather long, have a small degree of curvature, are very slender, and not compressed laterally as in other Bats. Their under surface is rather deeply hollowed out; in this respect they bear considerable resemblance to the claws of some Rasorial birds, such as the genus *Tetrao*, but they are relatively more slender. From their form they could scarcely be used as organs of suspension, and it is not improbable that the conspicuous discs attached to the thumbs and feet may answer the same purpose that claws are known to do in the ordinary Bats.

The elevated form of the cranium deserves special attention, as indicating an affinity in this particular with the genera *Furipterus* and *Natalus*.

The peculiarity of having the wing-membranes extended to the claws is not restricted to this genus, as I have observed it in the *Vesp. suillus* of M. Temminck. This species has been considered by Dr. Gray to be sufficiently dissimilar from other examples of the genus *Vespertilio*, to merit generic distinction, under the name of *Murina*. Another species from Ceram (*Vesp. vulpinus*, Temm., Mus. Ley.) possesses the same singular mode of attachment of the membranes. Not having carefully examined either of these, I am unable to offer any positive opinion respecting their affinity with the genera above described. It appears probable, however, that other characters would be discovered common to *Hyonycteris* and *Murina*, if a close examination were instituted.

* In taking the measure of the ear, it is my custom to consider it as a simple projection, and to measure along the line of greatest convexity of the hinder surface. This imaginary line will proceed from that part of the base nearest the crown, to the tip of the ear. A line along its anterior or posterior margin would be rather an indication of form than of absolute length, and should therefore be given additionally if the form of the ear seems to require it.

NOTICE OF SOME INDIAN TORTOISES (INCLUDING THE DESCRIPTION OF A NEW SPECIES PRESENTED TO THE BRITISH MUSEUM BY PROFESSOR OLDHAM). BY DR. J. E. GRAY, F.R.S., ETC.

The most interesting specimen of the very curious series of Indian Tortoises presented to the British Museum by Professor Oldham, is a fine full-grown example of a species which so strongly resembles the South American *Testudo tabulata*, in size, form and colours, that it might easily be mistaken for a specimen of that species which had been taken to India in some vessel. But on a closer examination it is easily distinguished from the American kind by the following particulars :—

First. It belongs to the Old World division of the genus, or the true genus *Testudo*, characterized by the last vertebral plate being only as wide as the caudal and the hinder half of each of the hinder marginal plates, instead of being of the width of the caudal and the hinder marginal plates, as is the case with the American "*Gophers*," including the species *Testudo tabulata* and *Testudo gopher*.

Secondly. It has a large, elongated, well-marked nuchal plate, which is never found in *Testudo tabulata*.

Thirdly. The hinder notch is more angular and acute.

The specimen sent from India has the deeply concave sternum, which is supposed to mark the male animals, as is the case with many specimens of *T. tabulata*. It is sent under the name of '*Testudo elongata*,' which I willingly adopt; as it may have been noticed under that name in some Indian periodical which has not yet come under my observation.

1. *TESTUDO ELONGATA*.

Thorax oblong, rather depressed, truncated in front, rounded behind, black; shield yellow-edged. Sternum rather narrow, truncated in front, angularly notched behind, yellow, largely black-varied. Nuchal plate elongate. The hinder vertebral plate as wide as the caudal and the hinder half of the hinder marginal plates.

Hab. India, "Mergui."

Note.—Since the above was written, I have received a Part of the Journal of the Asiatic Society of Bengal for 1856, and I find the following observations on this species, which appears to have been mentioned in a preceding volume :—

Testudo elongata, Blyth, Journ. As. Soc. Bengal, xxxii. 639. Vol. xxv. 1856, lxxxiii. 712.

Mr. Blyth states, "A number of living specimens have been received from Captain Berdmore.

"Colour of naked parts olive-grey varied with dull yellow."

Mergui, Tenasserim River.

2. *TESTUDO HORSFIELDI*, Gray, Cat. Tort. B.M. t. 1.

There is a fine large specimen of this species, showing that it is very distinct from the *T. græca* of Europe. The upper jaw has a small notch on each side of the tip.

3. *EMYS CRASSICOLLIS*, Bell.

The Collection contains three adult specimens of this species, which are marked "*Emys nigra*, Blyth."

The adult examples are rather broader than the younger specimens, in which a mucro is usually found, and the dorsal keels are almost entirely obliterated; the hinder edge of the thorax is acutely dentate; the sternum is pale greyish, with black areolæ and rays. It is probably the absence of the keels in the adult state that induced Mr. Blyth to regard it as a distinct species; but the keels generally become more indistinct in all the species which are keeled in their younger condition.

The specimens are marked as coming from "Mergui." The jaws are even, and not notched in front.

4. *EMYS NIGRA*, n.s., Blyth, Journ. As. Soc. Bengal, lxxviii. 712.

Mr. Blyth observes on the affinity of this species with *E. crassicollis*, but he does not appear to have the means of comparison.

The Collection contains two species of the genus *Batagur*:—

5. *BATAGUR BASKA*, Gray, Cat. Tort. B.M. t. 16.

There is a very large adult shell of this species, which is marked "*Emys tentoria*, Blyth." It measures $21\frac{1}{4}$ inches over the back, $19\frac{1}{2}$ along the sternum, and is 18 inches across the back and $21\frac{1}{2}$ over the convexity of the back. The jaws of the species are very strongly dentated; the upper one is toothed on the edge with two angular series of pits; the lower jaw is furnished with two concentric series of acute spinose tubercles, those in the outer series the largest and very acute, the central one in front horny, very large.

6. *BATAGUR OCELLATA*, Gray, Cat. Tort. B.M. t. 36.

There is a beautiful specimen of a species of this genus from Mergui, which I am inclined to believe is referable to *Emys ocellata* of Dumeril and Bibron (Erpétologie générale, ii. 329. t. 15. f. 1); a species which I have not before seen in any English collection. I should have no doubt of its being that kind from the description; but in the figures the dark spots on the costal plates are represented as being nearly regular, circular, broad rings round a pale circular centre, while in the specimen received from Professor Oldham the dark mark on the costal plate is an irregular oblong or square mark only, partly surrounding the paler centre of the shield.

Mr. Blyth in the same paper observes, "*Emys ocellata* would appear to be the commonest species in the Burmese rivers, and its naked parts are olive-grey, the crown blackish, with a yellowish-white V-like mark over the snout, continued as a supercilium over each

eye and back upon the neck, another straight line behind the eye, and both are often more or less broken into spots.

"Carapax dusky mottled with yellowish, a great black spot surrounded with a pale *areola* upon each discoidal (!) plate, dorsal ridges blackish with pale border, and lower parts wholly yellowish-white.

"Some are brighter coloured than others, and the ocelli become proportionally smaller as they increase in size.

"The carapax of our largest specimen measured 9 by 6½ inches, but it probably is not nearly full-grown."

Hab. Burmah.

7. *CISTUDO DENTATA*, Gray.

There is a fine adult specimen of this species in the Collection, also from Mergui.

BOTANICAL SOCIETY OF EDINBURGH.

December 11, 1856.—Professor Balfour, Vice-President, in the Chair.

The following papers were read:—

1. "Description of a Method of Preserving Plants of their Natural Form and Colour," by Thomas R. Marshall, Esq.

The plant should be placed in a box, in such a manner as to preserve the natural disposition of its parts; fine sawdust (perfectly dry) of box, or other hard wood, is then to be carefully sprinkled over it, taking care not to shift the position of the leaves. The plants ought to be quite fresh when put into the box. About a fortnight in the dust is sufficient to dry the plants in summer (in a natural heat); succulent plants require a longer time.

2. "On the species of Pine called in Moffat 'Dr. Walker's Pouch Fir,'" by Professor Fleming.

3. "On some new species of Marine Diatomaceæ from the Firth of Clyde," by Professor Gregory.

4. "Notice of Hepaticæ, found near Aberfeldy," by John Lowe, Esq.

The author enumerated fifty-five species.

The third meeting of the session was held on January 8, 1857.—Professor Balfour, Vice-President, in the Chair.

The following papers were read:—

1. "On the production of Ergot on Rye," by Kenneth Corbet, Esq.

The author stated that he found that native ergot was more certain in its medical action than that imported from the Continent.

2. "On a Monstrosity in the Fruit of *Silene inflata*, with some remarks on Placentation," by A. Dickson, Esq.

Mr. Dickson exhibited a specimen with partitions in the ovary. He considered that the specimen he produced went to support the view of central placentation in all cases, as suggested by Schleiden.

3. "Notice of Plantain Flour," by Murray Thomson, Esq.

Plantain meal is prepared by taking off the skin from the fruit, slicing the pulpy core, and then drying and powdering it. The meal has the odour of fresh hay or tea. It has a sweetish taste, and partially dissolves in the mouth. By analysis, 100 parts were found to consist of—

Water	12.33
Starch	71.60
Gum	4.42
Sugar	2.40
Cellulose	5.99
Plastic constituents—	
Albumen	2.01
Oil	0.50
Soluble Salts	0.64
	<hr/> 99.89

4. "Analyses of Three Australian Wines," by Murray Thomson, Esq.

The author had analysed three samples of wine sent to Professor G. Wilson from Australia.

No. 1. "Mitou:" resembled port wine in colour. The bouquet was good. It was found to contain 11.30 per cent. of alcohol, also sugar and tartrate of potash in small quantity, and traces of phosphate of lime and magnesia, acetic and sulphuric acids, and chlorine.

No. 2. "Frontignac:" resembled sherry in colour, also with a good bouquet, but rather sweet. It contained 16.00 per cent. alcohol, also sugar, tartrate of potash and soda, traces of lime and magnesia, acetic acid, and chlorine.

No. 3. "Casiquar:" had a port-wine colour, good bouquet, and rather sweet taste. It contained 18 per cent. of alcohol, also sugar, tartrate of potash and soda, traces of lime and magnesia, and phosphates, acetic and sulphuric acids, and chlorine.

These wines are pure and good, although not so showy or so full-bodied as the wines supplied from Spain and the other wine countries. Their poverty in bouquet may be accounted for by their comparative youth, being at most only three years old. Their all being acid may be explained by the circumstance that the sample bottles were not tightly closed. On the whole these wines are beyond the average of many wines sent to the British market, both as regards purity and strength. The cultivation of the vine and the manufacture of wine will no doubt be carried on extensively in Australia.

5. "On the injurious effects of *Urocercus gigas* on Fir-trees," by the Rev. A. Thomson.

The author stated that last summer his forester had observed a Scotch fir-tree about thirty-five years old die very suddenly. The tree was cut down and taken to the saw-mill. During the preparation of the wood a large fly was observed in a burrow in the wood. Subsequently another fly, a grub, and the remains of a cocoon were seen. The insect was examined, and found to be the *Urocercus gigas*. It

has been rarely noticed in Scotland. It appears, however, that in Germany it often causes great destruction in the forests.

6. "On the Occurrence of the Seeds of Bearded Darnel in inferior samples of Wheat," by George S. Lawson, Esq.

7. "Notes on *Pinus Cephalonica* and other Coniferæ, at Craigo House, Montrose," by Mr. P. S. Robertson.

Mr. Robertson read a notice of a large number of plants of *Pinus Cephalonica*, which are growing at Craigo House, about three miles from the sea, on dry sandy soil which overlies soft freestone rock, and in the vicinity of limestone. The trees had been raised from seed and planted about eighteen years ago. They appeared to be in perfect health, making growths of 12 to 15 inches each year; a good many having now attained to 12 and 15 feet in height.

Mr. Lowe made some verbal remarks on the effects of lightning upon Larch-trees. During the violent storm which occurred on the 7th of August last, a larch-tree, standing in a field at the west end of the village of Fortingal, was struck by lightning. Commencing about a yard from the summit, the electric fluid passed in a spiral direction down the trunk, making five-and-a-half coils in its descent, and peeling off the bark to the breadth of five or six inches. Half-way down the tree the current appears to have been divided by an intervening branch, and from this point the spiral coil is double, diverging as it nears the base, where one of the currents has passed into the earth to the west and the other to the east side, after having thrown down a portion of stone wall which opposed its progress. At the point of entrance of this current the earth was torn up, and a large opening left. Another larch, about a mile to the east of Fortingal, was struck in a similar manner and on the same evening.

MISCELLANEOUS.

Observations on the Pteropus of Australia.

By J. K. E. FAIRHOLME.

THE acquisition of a Flying Fox to the Gardens of the Society, induces me to bring before your notice a few observations I have made on the habits of this animal in the country about Moreton Bay, on the east coast of Australia, about lat. 27° south.

The flying fox is well known even in the southern parts of Australia in the summer months; but by far the largest flights are seen in the warmer latitudes. The attention is generally attracted to them (just as daylight disappears) by the heavy flapping sound of their wings, as they fly in great numbers overhead, all in the same direction. These flights often continue to pass for many hours together on the way to their feeding-places, generally about the banks of rivers, where the tree known as the Flooded-gum grows, on the leaves of which they feed. Though scattered over a large extent of country while feeding at night, they all contrive to assemble again to spend the heat of the day together, and when the flight is large, the scene

of congregation is most extraordinary. I am fortunate enough to have known two of these places of assembly—one on a small island in Moreton Bay, covered with dense scrub or jungle; another in the scrub, close to my former residence, about forty miles inland from the Bay. In the latter spot the scrub consists of the usual undergrowth of smaller trees, mixed with *bush ropes*, or lianes, and overtopped by enormous Moreton Bay pine-trees (*Araucaria Cunninghami*). On the nearly horizontal branches of the pines, as well as on the lower trees around, the flying foxes hang in vast numbers. I can never forget my astonishment as I approached this spot for the first time, being taken to it for the purpose of shooting some of the animals for the natives. The space occupied by the flight was, as near as I could judge, about 400 or 500 yards square, and in this, every tree was more or less loaded with them, all hanging with their heads downwards, and uttering a sound difficult to describe, but not unlike that of young rooks when crying for food. All that were not snarling and fighting for places, were steadily fanning themselves with their wings half extended as they hung. On our approach, most of those nearest to us took to flight, only to alight again on the next tree, or to wheel round and round in the air above the spot. On my firing a shot, the din increased, and continued to such an extent, that after I had shot what the blacks required, I was glad to get away from it. Many had young ones clinging to them, and suckling at the breast. This flight met in the same spot for several days, and then disappeared. The flesh of the flying fox is like that of a rabbit in appearance, but is strongly flavoured by the food on which the animal feeds.

On the coast of Moreton Bay the natives live principally on fish, and the arrival of the flying foxes on the little island of St. Helena is hailed by them as a change of diet. The flights only appear in the warmer months of the year, even in lat. 26° , and most likely migrate into the tropical latitudes during the colder months, like many of our Australian birds.

At Moreton Bay there is no difficulty in procuring any number of young flying foxes, as the island on which they congregate is close to the anchorage for ships.—*Proc. Zool. Soc.* July 22, 1856.

On the Metamorphoses of Trachys pygmæa. By M. LEPRIEUR.

Most of the known larvæ of the *Buprestidæ*, the family of Beetles to which *Trachys pygmæa* belongs, live in the interior of the trunks of trees, feeding on the woody tissue. Those of the present species were discovered between the two laminae of the epidermis of the leaves of some Malvaceous plants; they devoured the parenchyma, leaving the epidermis untouched, in the same way as the Lepidopterous and Dipterous leaf-miners. In this way they form a sort of dwelling resembling an inflated vesicle, in which they undergo their transformations.

Amongst the numerous researches made by Réaumur into the history of many of the leaf-mining larvæ, some refer to Coleopterous

insects principally belonging to the group of the *Rhynchophora* or Weevils. One of the figures given by that celebrated naturalist represents a mining larva which lives in the leaves of the Mallow, and which is evidently a species of *Trachys*.—*Comptes Rendus*, Feb. 16th, 1857, p. 314.

On a Monstrosity of Haliotis (albicans?).

By JOHN EDWARD GRAY, Ph.D., F.R.S., etc.

Mr. Cuming kindly showed to me a series of four specimens of Ear-shells, which he procured in Paris, and of which he has some other examples.

The four specimens are all peculiar for having an elongated continued slit occupying the place where the series of perforations is usually situated,—this slit extending more than one-third of the length of the spiral ridges on the outer or left side of the whorls; but it does not extend to the margin of the shell, and there is generally a more or less deep pit on the inner surface, in front of its extremity.

When I first saw the shell, I was inclined to regard it as a monstrosity; but when I considered the uniformity of the peculiarity in the specimens which I possess, and in those which Mr. Cuming had seen, I thought that it might be the type of a new form, for which *Schismotis excisa* would be a good name.

But a comparison of the shell with the specimens of *Haliotis albicans* in the British Museum from Van Diemen's Land, has induced me to believe that they are only varieties of that or some very nearly allied species, and that the peculiarity of their structure is produced by the locality they inhabit, the absence of the shelly matter on the branchial ridge being probably produced by the continued abrasions to which the shells have evidently been exposed, either by some chemical peculiarities in the water or the attack of parasitic animals.

All the specimens are in a very eroded condition, and two of them are very much pierced with a minute worm, and they all have the under valve of a *Hipponyx* attached on the left side near the circumference of the shell; one of these shells (which is generally the largest of the series) being placed in front of the slit between its termination and the front margin of the shell, covering the space which in the normal shell would be the place of one or two perforations.

If the exterior surface of a good specimen of *Haliotis albicans* is examined, it will be found that there exists a distinct narrow straight groove continued from one perforation to the other, and to the margins of the outer lip, which I have not seen so distinctly marked in any other species of the genus, indicating probably the suture between the overlapping of the two sides of the slit in the mantle of the animal, and this suture is marked but by a slight line on the inner surface of the shell. The same suture is to be observed in most other *Haliotidæ*, but they are generally not so distinct as in *H. albicans*, and much more sinuous.

I am inclined to believe that the slit in the specimens is to be considered as the imperfect filling-up of the shelly matter between the usual perforations, caused by the eroded and evidently diseased state of the specimens.

The interior of the shells is marked with a very rough tubercular muscular scar, which is not to be observed in perfect specimens of *Haliotis albicans*; but this will be found to be uniformly the case with most specimens of Ear-shells which have an eroded or worm-eaten outer surface, even in species which have a scarcely marked scar in their perfect or normal condition; so that this difference, like the slit, appears to depend on the state of the shell and the animal which formed it.

The interior of the shell presents a further peculiarity, but this is evidently caused by the same effects as the roughness of the muscular scar and slit on the branchial ridge, viz. there is a more or less deep broad groove on the inner surface between the slit and the sub-central muscular scar, which is more or less marked with regular cross grooves, and they are evidently impressions of the outer surface of the two branches of the gills.

Only one of the specimens I have seen shows any indications of the outer surface of the shell, and in that it only forms a band about one-fourth of an inch wide on the edge of the outer lip; it is pale, greyish, and concentrically striated, like the surface of the normal specimen of *Haliotis albicans*.

This kind of monstrosity was to be expected, as the mantle of the animal is slit under the perforations on the shell; and we have in *Scissurella* and in several fossil genera the perforations replaced by a more or less continued slit over the mantle. I have never before seen an Ear-shell with more than two holes united into a short slit by the absence of the shelly matter between them; but when we examine the *Haliotis albicans*, the existence of the more distant exterior groove renders it the species in which one would more readily expect such an abnormal formation to occur.

I have seen two specimens of two species of *Haliotis*, which exhibited just the converse deformity, being without any appearance of the series of perforations, the place of the holes being occupied by a continued convex spiral rib, like the second rib in *Padollus*. Most probably in this individual the mantle of the animal was without any slit, and hence the malformation, the water being admitted to the gills by the slight notch in front of the ribs, as in some *Emarginula* or *Scuta*.—*Proc. Zool. Soc.* May 27, 1856.

PERFORATED STRUCTURE OF RHYNCHONELLA GEINITZIANA.

To the Editors of the Annals of Natural History.

Belmont near Galway, March 10, 1857.

GENTLEMEN,—I am much gratified to learn from your last Number that Dr. Carpenter has examined some Russian specimens of *Rhynchonella Geinitziana*; inasmuch as his examination appears to confirm my suspicion that the German shell, so called, is “a different

species," as expressed, about a year ago, in the 'Annals.' I now write to state that I am preparing a supplement to my 'Notes on Permian Fossils,—Palliobranchiata,' in which the "distinctly and regularly perforated" histological structure of the German species will be more fully described than I have yet done, and proved to be like that "of any *Terebratulidæ*."

I cannot conclude without expressing my warm appreciation of the trouble which both Mr. Davidson and Dr. Carpenter have taken in this question.

I am, Gentlemen,
Yours very truly,
WILLIAM KING.

On the Nucleus of the Operculum of Cyclostoma elegans.
By JOHN EDWARD GRAY, Ph.D., F.R.S.

In my various physiological papers I have attempted to establish the fact that the opercula of shells are analogous to the second valve of a bivalve shell, and are in fact a counterpart of the other valve. I have shown that they are formed at the same time on the body of the Mollusca; that they have a peculiar mantle, similar to the mantle of the spiral shell, and that they are increased in size in the same manner.

On lately examining the operculum of *Cyclostoma elegans*, I was struck with the fact (which might have been foreseen when the first formation is considered) that they have a somewhat irregular nucleus or first-formed part, like the nucleus to be observed on the apex of the spire of most univalve shells, as shown in the accompanying figure, drawn and engraved by Miss Jessie Dunlop.



I may further observe, that the operculum of this shell is formed of two shelly plates, separated from each other by arched laminae concentric with the outer edge of the last whorl, placed under the concentric grooves of growth on the outer and inner surface, leaving a series of pores on the circumference in the groove between the two plates.—*Proc. Zool. Soc.* May 27, 1856.

On Object-slides of Canary Glass. By Professor ERNST BRÜCKE.

The light of a clear blue sky is well known to be very unfavourable for microscopic investigations. It is evident that it is not only the small quantity of the reflected light, but also its composition, that produces the injurious effect. The continental microscopes are generally adapted for the white or slightly yellowish light which is reflected from clouds, and the English ones for the yellowish-red light of the gas-flame partially neutralized by cobalt glass. They are never arranged with special reference to the blue light of the sky, because in those countries where the microscope is principally used, a completely unclouded sky is not the rule, but the exception.

We also know that the contemplation of any colour which has a certain degree of intensity, and which is diffused over the whole field of vision, is wearying, and in time injurious, to the eye. This applies not only to red and yellow, but also, to a less extent, to blue and green. For this reason green spectacles have gone out of use, and the blue ones are always selected of a weak colour.

Lastly, the troublesome and injurious nature of the blue light of the sky for microscopists may also be attributed to a third cause. The ordinary pictures of our microscopic objects are shadow-pictures, which fall upon our retina. Their unity and distinctness must consequently be destroyed when light is emitted by the objects themselves. Oberhäuser, therefore, furnishes his microscopes with a paste-board screen, which is used when the low powers are employed with transmitted light, to keep off the direct light, in order that it may not be reflected from the object and thus reach the field of vision.

Now we know, from the investigations of Stokes and Helmholtz, that vegetable and animal tissues are not free from (true) internal dispersion; and although this is so small that it is not observed at all in the ordinary mixed sun-light, yet it is by no means impossible that it might sometimes have an injurious action upon the microscopic picture, when the rays of great refrangibility have acquired an unusual preponderance in the light falling on the object.

All these various circumstances indicate that in the blue light of the sky we should endeavour to weaken the strongly refractive rays in comparison with the less refractive. This may be effected by the insertion of a medium which exerts a strong absorption upon the violet end of the spectrum; but amongst such media, those which do not completely destroy the absorbed light, but, instead of it, emit rays of greater length of vibration, should be selected. One of the best of these media is canary-glass, and this must be particularly applicable to the purpose, as, according to the description of its optical properties given by Stokes, it will fulfil the above requisites, and it may be procured cheaply and without difficulty.

Experiments made with it completely fulfil these expectations. Object-slides of canary-glass considerably improve the blue light of the sky; and even when we have the light reflected from white clouds, in certain cases, the conditions of which are not yet ascertained, it is

pleasanter to work with them than with object-slides of common glass. The author's object-slides of canary-glass of medium colour are 2-3 millim. in thickness. The thicker ones are more serviceable than the thin ones, so that they may be employed with advantage of a thickness of 3-4 millim.—*Sitzungsber. der Akad. der Wiss. zu Wien*, xxi. p. 430.

On two New Species of Humming Birds belonging to the genus Amazilius. By JOHN GOULD, F.R.S., V.P.Z.S., etc.

AMAZILIUS CERVINIVENTRIS, Gould.

Head, all the upper surface and wing- and upper tail-coverts bronzy-green; wings purplish-brown; tail dark chestnut-red, each feather narrowly bordered and tipped with a bronzy lustre, which is of greatest extent and most conspicuous on the two centre tail-feathers; throat and chest luminous green; under surface of the shoulder and flanks dull green; abdomen and under tail-coverts fawn-colour; thighs white; upper mandible yellow at the base, merging into brown and tipped with black; under mandible pale yellow, except at the tip, which is black.

Total length, 4 inches; bill, $\frac{1\frac{1}{2}}{8}$; wing, $2\frac{1}{4}$; tail, $1\frac{1}{2}$.

Hab. Cordova, in Mexico. Collected by M. Sallé.

Remark.—This species is about the size of *A. Riefferi*; but its bill is less robust; the wings, as in that species, are uniform purplish-brown; the chestnut colouring of the tail-feathers and the under tail-coverts is of a somewhat lighter hue.

AMAZILIUS CASTANEIVENTRIS, Gould.

Crown of the head, upper part of the back and shoulders reddish-bronze; rump and upper tail-coverts greyish, with a bronzy lustre; wings purplish-brown, with the exception of the basal portion of the primaries and secondaries, which are rufous; tail dark chestnut, tipped with a bronzy lustre, of greatest extent and most conspicuous on the centre feathers; throat, fore part of the neck, breast, and upper part of the abdomen shining golden-green; under surface of the shoulders, lower part of the abdomen and under tail-coverts fine chestnut-red; thighs white; upper mandible brownish-black; under mandible fleshy-yellow, except at the tip, which is brownish-black.

Total length, $3\frac{1}{2}$ inches; bill, $\frac{1}{4}$; wing, $2\frac{1}{8}$; tail, $1\frac{1}{4}$.

Hab. Santa Fé de Bogota. From the Collection of Mr. Mark.

Remark.—This species differs from *A. cerviniventris* in the much greater depth of the chestnut colouring of the abdomen, under tail-coverts and tail; in size it is considerably less than that species, being even smaller than *A. Arsinoë*, to which it offers an alliance in the colouring of its wings, but from which it differs in the colouring of its abdomen; the white feathers of the thighs are much developed and very conspicuous.—*Proc. Zool. Soc.* June 10, 1856.

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XXVI.—*Researches on the Development of the Pectinibranchiata.*
By J. KOREN and D. C. DANIELSEN*.

[With two Plates.]

THE development of *Buccinum undatum* and *Purpura lapillus* differs so much from anything already known, that we cannot be astonished that the correctness of our former observations has been doubted. To dissipate these doubts, and remedy the imperfections which occur in our first work, we have thought it necessary to recommence our researches; and now, in publishing the results, we can compare them with the investigations of J. Müller†, Vogt‡, Krohn§, Leuckart||, Gegenbaur¶, and Carpenter**, on the marine Mollusca, with which science has recently been enriched.

Buccinum undatum, Linn.

The capsules which enclose the eggs are connected together, and form round or oval groups, which may attain a considerable size. They are often attached to different bodies, for example, to stones, old pieces of wood, oysters, &c.

* Translated by W. S. Dallas, F.L.S., from the 'Fauna littoralis Norvegica,' by M. Sars, J. Koren, and D. C. Danielssen; Bergen, 1856.

† Ueber *Synapta digitata*, und über die Erzeugung von Schnecken in Holothuriën. Berlin, 1852. Transl. Annals, new series, vol. ix. 1852, pp. 22 & 103. Ueber die Entwicklungsformen einiger niedern Thiere (Berlin Monatsber. 1852, p. 595).

‡ Bilder aus dem Thierleben. Frankfurt, 1852, p. 290.

§ Archiv für Naturgeschichte. Berlin, 1853, p. 223.

|| Zoologische Untersuchungen. Giessen, 1854, 3 Heft, p. 64.

¶ Untersuchungen über Pteropoden und Heteropoden. Leipzig, 1855.

** Quarterly Journal of Microscopical Science, 1855, no. xi. p. 17.
Ann. & Mag. N. Hist. Ser. 2. Vol. xix. 23

They are frequently very delicate and transparent, especially when they have not long been deposited. It is then very easy to observe the eggs which are enclosed in them. The capsules which have hitherto served for our observations were freshly deposited, so that we were able to follow the development in all its stages.

Each capsule is filled with a viscous humour, as transparent as water, and resembling white of egg; it contains a multitude of eggs (from 600 to 800). The latter vary a little in volume, from 0.257 to 0.264 millim.; and each of them, as we formerly stated*, is furnished with a delicate chorion and with a vitelline membrane closely surrounding the vitellus, which is composed of large or small granules, of a nearly round form, and of the vitelline liquid (*liquor vitelli*). The large granules are clear, of a more oval form, and refract the light strongly; they appear to be of an oily nature. The small granules are all of a dark colour, and round; they are scattered amongst the larger ones. We have found no germinal vesicle, but at the position ordinarily occupied by this, the vitelline mass was still clearer, and in the midst of this [clear] mass we perceived a little clear vesicle.

The first transformation of the eggs was, that the small clear vesicle, of which we have already spoken, approached the periphery of the vitellus, where it could be more easily seen. It extended itself over the vitelline mass, and formed upon it a spherical eminence, which was covered by the vitelline membrane; it had a rounded form, was as clear as water, and contained two or three molecules.

Some days afterwards, we remarked that the eggs had approached each other more closely, that the clear body had advanced still more over the vitellus, and that it had not only pushed the membrane before it, but had at the same time extended the chorion, so that the latter formed an arch. On the eighteenth and nineteenth days, the capsules have usually become a little altered; they are rather clearer at the upper part, the eggs having slipped down to the bottom of the capsule.

The enclosed liquid was not so viscous as before, and the clear body, in many eggs, had traversed the chorion and become dispersed in the liquid; whilst, in others, it was still united with the vitellus by a slight pedicle, formed by the vitelline membrane. In these the chorion was much enlarged, and ruptured at the highest point. In the pedicle there were no

* Here, as in many other places, we must refer the reader to our previous investigation of the history of the development of the Pectinibranchiata.

traces of vitelline molecules. The little body of which we are speaking was first observed by M. Carus, and subsequently by MM. Dumortier, Pouchet, Van Beneden, Bischoff, F. Müller, Nordmann, Vogt, Rathke, Kölliker, Reichert, Leydig, Lovén, and many others. Some of these authors take it for the projected germinal vesicle, others for the germinal spot, and others again for a drop of exuded vitelline liquid. Like M. Lovén, we formerly regarded it as the germinal spot, but new observations have caused us to change our opinion, so that we now agree with Rathke, Leydig, and Leuckart. Another question, which has greatly attracted the attention of naturalists, is to ascertain whether this body has anything to do with segmentation. There is much difference of opinion upon this point amongst authors. Rathke, Pouchet, Reichert and Leydig entirely deny any such connexion. F. Müller, Nordmann, and Lovén believe that this body shows the direction in which the segmentation takes place. As most of the eggs of *Buccinum undatum* do not undergo segmentation, and in the small number which pass through the stages of this process this body is pushed out of the egg before segmentation commences, it is clear that we cannot speak of any relation between the latter and the body pushed out. Soon after this little body has escaped from the eggs, we see that the latter begin to agglomerate. The humour, which was previously thick and viscous, then becomes more liquid, so that there is no longer any difficulty in getting out the contents of the capsules. The chorion has already begun to detach itself in most of the eggs, forming a mass in the humour.

Some days afterwards, the act of conglomeration is completed; the eggs appear to be agglomerated at the bottom of the capsule. The viscous humour has become perfectly fluid, like water, and round the agglomerated eggs we see a greyish, finely granular, semitransparent mass, which assists in joining the eggs together (Pl. XVI. fig. 1 *a*). The chorion is redissolved in most of the eggs. In a little while we observe a group in the conglomerate formed by the whole of the eggs,—a larger or smaller number of eggs appearing to be wrapped up in a transparent veil formed by a viscous and finely granular humour exuded from the eggs. This humour contracts by degrees, and forms a very delicate membrane, which separates the group more and more from what surrounds it. A group of this kind, when recently formed, has much resemblance to a heap of balls placed one upon the other (fig. 1 *b*). The exudation of the finely granular humour continues, which enlarges the membrane, principally at the upper part, the narrowest part of the group. We also perceive slight contractions in the membranous envelope,

which cause the eggs to press against each other still more (fig. 1). We cannot as yet find any trace of the formation of organs; the exuded mass is homogeneous and semitransparent, but usually becomes more and more abundant above, until at last it exhibits on the upper part of the membrane some extremely fine cilia. Soon after the formation of these, we see some cirrhi, and it is only then that the movements of the embryo commence. As the cirrhi become more numerous and larger, the movements become more and more lively; and shortly afterwards the embryo detaches itself from the common mass. This separation sometimes takes several hours, and often carries away with it a portion of the eggs, which, being still separated from the embryo, die. The above-mentioned exudation, to which we have paid attention in our first memoir, differs in its quantity; for sometimes it happens that it only makes its appearance as a border or clear line within the membrane, and in other cases it may be very considerable before the embryo has detached itself. The number of eggs which take part in the conglomeration to form the embryo varies as much as the quantity of embryos in the different capsules. The ordinary number of eggs which collect to form one embryo is from thirty to sixty, but we have very frequently found that it was composed of 180 eggs. It is to be observed, that the fewer the individuals [embryos] in a capsule, the greater the number of eggs of which they consist, and consequently the individuals are always larger. The form of the embryos also undergoes some variations, but they are ordinarily oval or reniform. The number of individuals also varies greatly; thus sometimes we have found five or six, sometimes eighteen to twenty-four, and even thirty-six. Gray says that a capsule contains more than 100 eggs, and that only four or five young are excluded from it. Howse shows us twenty-four; he also describes egg-capsules, which, he says, belong to *Fusus Norwegicus* and *Turtoni*, and of which those of the former only contain two or three embryos, and those of the latter six.

Now that we have seen how the eggs are grouped together, and how the exudation takes place, as well as how the commencement of the embryo is formed, we may follow their development. When the cilia and the cirrhi make their appearance in sufficient quantity upon the upper part of the membrane, the differentiation of the organs commences in this exuded and homogeneous mass, for we begin to see slight outlines of the rotatory organs, which then very rapidly acquire their peculiar forms. But almost at the moment of their appearance we observe the foot as a dense and almost square mass, which is still adherent to the rotatory organs. As soon as these increase in size, the foot acquires a more and more rounded form, detaches itself

from them, becomes thicker, and acquires a yellowish tint and a cellular structure. Cells are also formed in the rotatory organs, but these are neither so compact nor arranged so much upon one another as in the foot. On the margins and on the surface of the latter we observe very fine cilia.

The rotatory organs are extremely clear and transparent. Vogt* has best described their form, and, as our observations agree with his, we shall not speak of them. We shall only remark, that the cirrhi are shorter in *Buccinum undatum* than in *Acteon*. The foot advances considerably in front, and we soon observe the two auditory organs at its base (fig. 2 g). These consist of two round, clear vesicles, which are filled with a fluid as limpid as water, and exhibit double outlines; each vesicle is furnished with a single otolith. When the embryo is compressed with a little force, the otoliths almost always break into four regular fragments. The tremulous movement which most authors have observed in the otoliths has not been remarked by us in *Buccinum undatum*; and, although we have employed pretty high magnifying powers, we have been unable to discover the cilia on the inner wall of the vesicle.

Whilst the rotatory organs and the foot are being developed above, the membrane surrounding the lower part of the embryo grows thicker, its outlines become strongly defined superiorly by a distinct margin, and it thus forms the mantle (fig. 1 d, d, d). This increases by a permanent exudation from the vitellus, and cells are successively formed in the mass. On the bottom of the mantle, a round, transparent, and membranous shell is then formed (fig. 2 a). At the same time we observe, at the two sides of the base of the foot, the two salivary glands, which are pyriform (fig. 1), and in which round cells are formed by degrees. Their lowest portion, which is the largest, is filled in the centre with a multitude of pigment grains, very strongly coloured. Almost at the same time, we perceive the place of the mouth and pharynx, and traces of the heart. The buccal orifice forms a pretty large cleft, which is furnished with cilia; it occurs at the point where the two rotatory organs meet in front. It is continued into the pharynx, which has the form of a funnel, broad above and narrow beneath; all its inner portion is covered with cilia. Grant† was the first who observed the heart in *Buccinum undatum*, and called attention to its strong pulsation. He also pointed out that the embryos of *Purpura*, *Trochus*, *Nerita*, *Doris*, and *Æolis*, had at the sides of the head two round organs covered with twisting cirrhi, by which movement was effected. He did

* Annales des Sciences Naturelles, 3 série, vi. p. 44.

† Edinburgh Philosophical Journal, vii. p. 121. Unfortunately we only know this Journal from the extracts given by other authors.

not, like Forakål, observe the shell; but Sars was the first to confirm Forakål's observations regarding the shell.

At the point where the heart makes its appearance, we see first of all a transparent, greyish, and finely granular mass, of a nearly round form, and placed close to the common membrane, which has assisted in forming the rotatory organs and the foot above, and the mantle below. Some contractions soon show themselves in the membrane, exactly at the spot where the greyish exuded mass just mentioned occurs. We then perceive some small and extremely fine muscular tubes, which indicate the direction of the contractions. These become stronger and stronger, and as no limitation has yet taken place, we see the contractions extend over the mantle, the foot, and the rotatory organs. During the contractions, the membrane at the spot where the heart shows itself gradually acquires the form of a vesicle, the outlines of which become more and more distinct, and in the walls of which we discover several muscular tubes. By thus becoming limited, the membrane forms the heart, which then detaches itself from the rotatory organs, from the foot and the mantle, and is situated to the right on the back (fig. 2 *d*). The heart takes a very oblique position, and is quite naked externally. Subsequently its walls become stronger, and enlarge; the muscular tubes are multiplied, transverse tubes are formed, and it becomes filled with a fluid as limpid as water (fig. 8 *f*). We have often counted the pulsations, and found that they vary in rapidity; we may usually count forty to fifty pulsations in a minute; but these strokes are not always regular, for after some feeble beats, we may observe that the pulsation is stronger. It also frequently happens that the heart suddenly ceases beating, and is, as it were, in a state of repose for some time. After a rest of this kind, the pulsation is much stronger. The primary tubes of the heart are cylindrical and dilated in some places; their walls are excessively delicate and shining, and they refract light quite differently from the rest of the mass. We have not observed any fluid in these tubes, nor have we remarked any cellular structure. In the rotatory organs we observed similar muscular tubes, but here several are seen to approach each other, and in many places it may also be remarked that they ramify. This ramification becomes more and more abundant as it approaches the periphery of the rotatory organs; and as the finest branches cross each other, there appears a muscular network which serves to move the organs, of which we have just spoken, in all directions. Amongst these muscular ramifications there are some small calcareous granules, scattered in the mass, which strongly refract light.

In our former memoir we stated that the eyes were formed at

the same time as the auditory organs ; but, according to the investigations which have since been made, this is not the case, for the eyes can only be perceived a little while after the formation of the auditory organs. Leydig has pointed out that at first the eye is a vesicle occurring at the base of the tentacles. We have had the opportunity of confirming his remarks, but we have also found that the inner wall of this vesicle is furnished with cilia. This vesicle is filled with a liquid, in which there is a multitude of strongly-coloured, yellowish pigment-grains, which are surrounded by an extremely delicate pellicle. When the cilia acted upon the pigment-grains, the latter acquired a rolling motion. We were unable to observe the lens ; it does not appear until a later period of development. In observing the eyes, we also saw the two conical tentacles.

As we have already stated, the *pharynx* is one of the first organs to make its appearance ; some time afterwards, the proboscis, the stomach, and the *œsophagus* show themselves. The latter makes its appearance as a cylindrical cavity surrounded by the proboscis, and in its excessively delicate walls we perceive several very clear lines, which are the earliest-formed muscular fibres. As soon as the *œsophagus* issues from the proboscis, it bends a little backwards and upwards, follows the lower part of the proboscis for some time, then again describes a curve by bending a little to the left, and enters the stomach. It is very difficult to follow the *œsophagus* during its development, as it is not only surrounded by the proboscis, the walls of which are thicker and less transparent, but it is also completely covered by it. This is the reason of our being unable to decide whether the whole length of the *œsophagus* is formed at once, or whether it becomes elongated by descending towards the stomach. The latter appears at first almost in the form of a ball, and seems to be formed by a single vitellus secreting a greyish, semi-transparent mass, which solidifies and forms a delicate membrane, which is first of all produced upwards and unites with the *œsophagus*, and afterwards downwards to form the rudiments of the intestines, which curve to the right, there form a curvature, pass to the opposite side, and lastly terminate by an anus in the branchial cavity (fig. 8 *t*). The stomach is always filled with a crowd of vitelline granules, which are continually rolling : this movement is caused by cilia, with which the whole of its inner surface is covered. It is not only the inner wall of the stomach that is clothed with cilia, but also that of the *œsophagus* and the whole intestinal canal.

It is only now that we observe the first traces of the nervous system, which are recognizable by two oval, yellow, and compact bodies (cerebral ganglia) surrounding the *œsophagus*. At

the same time that we observe these, we see the traces of the two pedal ganglia, which are placed side by side, more or less oblong, and of a deep yellow colour.

The margin of the mantle extending upon the dorsal surface of the animal forms a cavity clothed with cilia, in which the heart and the branchiæ are placed. The first traces of the branchiæ were two scarcely visible cords, which, originating from the margin of the mantle, met below, and formed an interlacement. When the development was further advanced, we saw that these cords were tubes which formed several loops, and that by this means they had some resemblance to a corkscrew. The loops were smaller above and below, whilst in the middle they were broader and closer together. A brisk movement, produced by cilia, was soon observed on their inner margins. In his memoir Lovén* has stated, that as regards the development there exists a great resemblance between the Gastropoda and the Acephala. In the latter he has shown how the branchiæ are formed, and we have had the opportunity of observing that this formation takes place in the same way in *Buccinum undatum* and *Purpura lapillus*.

Nearly at the same time that the formation of the branchiæ takes place, there appears at the bottom of the branchial cavity a vesicle which is formed by the secretion of a greyish and semitransparent mass. Muscular fibres soon make their appearance in this mass. The vesicle is oval and nearly pyriform, and terminates below in a pretty long canal, which follows the course of the intestine, but loses itself in the dark vitelline mass. We could not observe any communication between the canal and the heart, as was observed by Gegenbaur in the Pteropoda. When the development is further advanced, the latter divides into two chambers, of which one is smaller than the other. Between these chambers there is a valve, which is always in motion. The walls of the vesicle are delicate, semitransparent, and furnished with a multitude of muscular and varicose tubes, which run in all directions, longitudinally and transversely. These tubes are smaller than those in the heart; for this reason a higher power is necessary to observe them well. The contractions of the vesicle coincide with the dilatations of the heart (and *vice versa*), although it is impossible to perceive any communication between these organs. It is filled with a clear fluid, in which a great many dark molecules are found. We think that this organ is a commencement of the kidney.

Some time now passes without the appearance of other organs, and everything seems to cooperate in completing all that has

* Bidrag till Kännedomen om Utvecklingen af Mollusca Acephala Lamellibranchiata, p. 96.

been commenced. The head and back become more and more visible, and covered with fine cilia; we also perceive cilia on the tentacles, which have become longer. The eyes have acquired a more conical form, and we see the lens in them distinctly. The proboscis and the tongue are completely developed, and on the latter we see the armature as described by Lebert and Lovén. The salivary glands are now large enough to enable us perfectly to trace their excretory duct, which follows the œsophagus upwards. The siphon, furnished with cilia, is then clearly perceptible. The foot has changed its form, and become longer; from its upper part two rounded lobes arise. As regards the structure of the foot, it is composed of a multitude of primary, cylindrical, muscular tubes, which are also varicose, and cross each other in all directions, without, however, forming a mass. In the interior of the tubes we observed neither nucleus nor cells.

In this period of development the nervous system becomes tolerably visible. We observe the two large cerebral ganglia (Pl. XVII. fig. 1 *a, a*), which are of an oval form, and between them two smaller ganglia (*b, b*). From the lower part of each large ganglion a short and thick nerve arises (*h*), which joins the branchial ganglion (*d*), and from the upper part a more delicate and rather longer branch, which runs to the eye (*l, l*). The small cerebral ganglia are round, and about half the size of the large ones. Each of them gives off a slender branch (*k, k*) to the auditory organs, and another, a little stouter (*g, g*), to the two pedal ganglia (*c, c*). The latter are of an oblong form, and it is in their broadest part, which is turned towards the cerebral ganglia, that the two nerves just mentioned lose themselves; these two nerves start from the smaller cerebral ganglia. From the broadest part of each [pedal] ganglion starts a pretty strong nervous branch (*i, i*), which meets on the left with the branch which the large cerebral ganglion sends off to the branchial ganglion; to the right this same branch meets with the branchial ganglion, but without joining it. Nearly at the middle of each pedal ganglion a nerve (*m, m*) originates, which runs to the lobate foot, and at this point forms a small ganglion (*f, f*), from which three branches (*o*) arise. The narrowest part [of the pedal ganglia], on the other hand, gives off several branches (*n, n*) to the part of the foot which is furnished with an operculum. The branchial ganglion is of an oblong form; its largest part turns upwards, and it is in this that the three branches, to which we have referred above, lose themselves, so that this ganglion is in communication with the two large cerebral ganglia, and with the pedal ganglia. From its narrower part, which goes downwards, originates a thick nervous trunk (*p*), which termi-

nates in a ganglion (*e*). From the same part arises a more delicate branch, which runs to the heart (*g*). From the ganglion (*e*) issue two branches (*rr*), which pass to the intestines. When the animal is perfectly developed, the ganglia unite, and form a single cerebral mass.

The shell, which, at the commencement of the formation of the embryo, was very delicate and membranous, and which was at first of an oval or reniform shape, subsequently acquires the form of a Nautilus, but becomes more oblong by degrees. The calcareous matters then begin to be deposited in great quantity, so that a layer of transverse and longitudinal striæ is distinctly formed, causing the shell to be less transparent than before. However, the internal organs may still be seen. Both the heart and the vesicle have become divided into two chambers, of which the superior is the smaller. We also observe a strong muscle which starts from the inner face of the shell, and passes to the foot (Pl. XVI. fig. 3 *r*). Finally, we observe a small dark body, consisting of cells containing a yellow pigment; almost immediately afterwards, a similar body makes its appearance quite close to this, and this is followed by a third. These three bodies become blended together, and form the liver, which is somewhat oblong (fig. 3 *u*). On the inner wall of the mantle we perceive a series of folds, in which a mass of mucous glands is situated (mucous laminæ). In proportion as the young animals grow, still more calcareous matter appears in the shell, the mantle becomes thicker, and it is almost impossible then to distinguish the internal organs. The two rotatory organs have completely disappeared, and behind the tentacles we see a raised line, which shows the position in which they were situated. The shell has acquired a yellowish colour, and become hard, brittle, and only semitransparent. When the young animals abandon their capsules, they begin to creep, with the tentacles, the foot, and the siphon extended. They differ from the adult animal only in the shell, which has not, as yet, more than one or two turns of the spire. At the end of five months, the shell is completely developed, and if we examine a young animal in this stage, we do not yet find any traces of the organs of generation, and the grouped eggs still fill the hinder part of the shell.

This is the way in which the development of *Buccinum undatum* usually takes place. Thus only by an assemblage of well-organized eggs coming together to form the embryo, can it, in its ulterior growth, attain such a perfection as to be in a condition to continue an independent existence. But, by the side of this extraordinary development, comes a series of phenomena, which, on the one hand, follow the ordinary law of the development of animals of the lower classes, and consequently differ

greatly from the rule which we have given for the development of *Buccinum undatum*; and, on the other hand, prove that a single egg cannot furnish sufficient materials for the future perfection of the animal.

We have observed that in each egg-capsule there were one or more eggs which, not being included in the act of conglomeration, passed into a separate development. Even before the mass of eggs is perfectly conglomerated, we see some which undergo a segmentation, which, however, is subjected to many changes. Thus the vitellus divides into 2 equal and opaque spheres, each of which again divides into 2 other equal spheres, so that we then distinguish 4 equal spheres; each of these divides in the same way into 2 equal spheres, and this division continues until the vitellus resembles a mulberry. But it is not rare for the process of segmentation to stop at the formation of the first 2 spheres of segmentation, which begin to exude a clear humour, and this, almost at the moment of exudation, changes into a delicate membrane (Pl. XVII. fig. 6). As the exudation increases, the membrane enlarges, and by degrees its upper surface is covered with cilia, and soon with cirrhi. The embryo thus formed begins to turn upon itself even in the fluid (fig. 7). This, however, is not the usual way in which the formation of embryos takes place in isolated eggs, for it very often happens that the exudation and the development of the embryo do not commence until the segmentation is well advanced, and after the formation of 4, 8, or even 16 spheres of segmentation (figs. 8-12).

Whether the segmentation goes through all its stages, or stops at the first, it is certain that when the above-mentioned exudation has commenced, the segmentation ceases, and the formation of the organs begins. Before entangling ourselves more deeply with the development of these embryos, we must compare our observations on those eggs of *Buccinum undatum* which undergo segmentation, with those of other naturalists upon the process of segmentation in different Mollusca.

C. Vogt has observed, that when the first 4 spheres of segmentation are formed, there are produced between them 4 other small spheres, which set themselves in action and form the rudiment of the peripheric organs, whilst the central spheres remain longer without alteration. He thinks that these 4 small spheres of segmentation may be formed by exudation from the larger spheres. Leuckart has made the same observations upon the development of the Heteropoda. J. Müller has observed that the germinal vesicle in *Entoconcha mirabilis* does not disappear, but divides, and forms the clear bodies in the spheres of segmentation. At first 2, and then 4 large spheres of segmentation are formed; they are opaque, and each of them is furnished with

a small, clear nucleus. After the formation of these, we distinguish 4 smaller spheres, which are clear and furnished with a similar clear nucleus. These latter spheres have a cellular appearance. J. Müller found it impossible to explain how these little spheres issue from the large spheres of segmentation. These 4 clear spheres multiply rapidly, however; their number may reach 8, 16, or even more, whilst the 4 large opaque spheres remain inactive. Even after the cilia have made their appearance round the cellular peripheric layer, the 4 large spheres of segmentation have undergone no change.

Gegenbaur has also observed that in the Pteropoda the germinal vesicle divides, and that it forms first 2 and then 4 large spheres of segmentation, of which one of the latter again divides into two. He thinks that the peripheric layer is formed by one of the 4 spheres of segmentation which has become changed into a layer of clear cells. The 3 central spheres also remain inactive at first. In *Hyalea tridentata* one of the 2 spheres of segmentation divides into 2 smaller ones, and these into 2 others, until a mass of clear cells is formed surrounding the inactive sphere of segmentation. It sometimes happens also that this divides into 2 equal spheres.

Another modification observed in regard to the process of segmentation in *Hyalea* is, that the vitellus divides into 2 unequal spheres of segmentation, the largest of which again divides into 2, producing 3 equal spheres. One of these also divides into several smaller spheres, and forms a peripheric layer which surrounds the 2 inactive spheres.

Thus we see that, even in the same species, the segmentation may undergo considerable alterations. We have already seen that in *Buccinum undatum* the germinal vesicle disappears, and that there is no clear body in the spheres of segmentation. We have also remarked, that although the greyish, transparent mass already mentioned is exuded in various stages of segmentation, this nevertheless occurs most frequently when the vitellus is divided into 4 or 8 segments. This exuded mass must be regarded as the peripheric layer already mentioned, for we soon observe in it a cellular structure which forms the rudiments of some external organs,—the rotatory organs and the foot,—whilst the central part and the true spheres of segmentation appear to remain long without alteration (Pl. XVII. figs. 5–12).

In describing the ordinary development of *Buccinum undatum*, we have endeavored to explain clearly the way in which the organs are developed; and as the embryos which issue from a single egg do not appear to present any modification of development, it would only give rise to a repetition if we were to describe the formation of the organs here.

As soon as the rotatory organs and the foot are formed, we see the otoliths, the salivary glands, and the nascent shell; the spheres of segmentation then become less dark, the embryo enlarges, the foot becomes thicker, and in the interior we perceive a movement of rotation, which indicates the nascent stomach, from which a tube, the pharynx, is soon produced upwards, rounded in the form of a funnel. But whilst this takes place, the vitelline mass has greatly diminished, at the same time that the spheres of segmentation, which were previously compact and opaque, appear to be less compact and more transparent. A tube is produced downwards from the stomach, which, however, soon stops, and in which we see a rolling movement (the rudimentary intestine). The rotatory organs increase greatly in size, giving the embryo a very brisk motion. The foot becomes thicker and the pharynx firmer, and whilst all this is taking place, the vitelline mass diminishes to such an extent, that at last we can only distinguish a few traces of it. The embryo is, properly speaking, perfectly transparent, and thus acquires an airy appearance, which, coupled with its very brisk movements, renders observations very difficult. Some time then elapses without any fresh changes being observed, no new organ makes its appearance, and the last traces of the vitelline mass disappear entirely. But from this time we observe a retrograde tendency; the embryo becomes smaller and the foot thicker, whilst the rotatory organs shrink, and the part where the shell is situated becomes round, so that the whole acquires the form of a balloon. As the organs disappear, the vital force gradually diminishes, and at last we have before us a little shrivelled monster, which exhibits a slight ciliary movement, but which otherwise remains quiet at the bottom of the vessel until it dies. This is the case with all the embryos which are developed from a single egg; they have but a short existence, during which only a few organs are formed.

There is not much difference in the development of those which are evolved from two eggs. Thus we have observed that where two eggs unite, the vitelli undergo no segmentation, but a rapid exudation of a greyish and semitransparent mass takes place. This mass becomes firm, and converted into a membrane, on which cilia are formed. The embryo is then formed in the same way as that which is developed from a single egg, except that it is larger and stronger. When the foot, the rotatory organs, the salivary glands, the stomach, the œsophagus, and the intestines are formed, we see that a portion of the vitelline mass is used up, and we then perceive a slight contractile movement in the direction of the rotatory organs, which indicates the future heart. This takes more and more the form of a clear vesicle, in which we detect some muscular tubes. The contrac-

tions are not very strong. The embryo has then increased in size, both the intestines and the œsophagus have become longer and thicker, whilst the greater part of the vitelline mass has disappeared. We can discover no more new organs after this period; the remainder of the vitellus entirely disappears, and the embryo shrivels greatly, becomes deformed, and dies. Thus when 2 eggs united, a new organ, the heart, made its appearance, although without developing itself perfectly. We have also seen 3 eggs cooperate: the same phenomena were presented, the only difference being that the organs were more strongly developed, so that the heart became more muscular, and the intestines longer; but as the vitelline mass was exhausted before any other organs made their appearance, the embryo began to shrivel, and died. (See Pl. XVII. figs. 13-17.)

[To be continued.]

XXVII.—*A Revision of the Genera of some of the Families of Conchifera or Bivalve Shells.* Part III. Arcadæ. By JOHN EDWARD GRAY, Ph.D., F.R.S., F.L.S. &c.

[Continued from vol. xiii. p. 418.]

Fam. ARCADÆ, Gray, Ann. & Mag. N. H. xiii. 417.

Tribe I. ARCAINA.

THE hinge of the more typical form of this family consists of two oblong or linear teeth in each valve, one placed on each side of the line directly under the umbo of the shell. These teeth are divided transversely into cross-ridges, alternating and interlocking with the cross-ridges of the teeth of the opposite valve.

The teeth may be compared to the lateral teeth of *Spisula* in *Macrada* and *Meretrix* in *Venerida*, and more especially to the teeth of the genus *Trigonia*; only in this family, instead of the teeth being grooved on the sides, the grooves are sufficiently deep to divide the teeth into transverse interlocking plates.

The separation of what has been usually regarded as a continuous series of teeth into groups, each forming a distinct tooth, like the teeth of *Trigonia*, has been overlooked by conchologists, though it was noticed by me in the 'Synopsis of the British Museum,' in 1840, p. 143, thus: "The hinges of the valve consist of a number of transverse interlocking teeth, which appear to be formed by the subdivision of two elongated lateral teeth."

The space which separates these two teeth or groups of plates

is always to be distinctly seen under the apex of the umbo, even in those species of *Arca*, like *A. Noë*, which have a linear series of numerous nearly uniform plates.

In most species the two teeth or groups of cross-plates are of nearly uniform size and disposition; but in some the anterior tooth is very small, as in the genus *Argina*, and in the allied genus *Lunarca* the small anterior tooth is entire, and not divided into cross-plates; in *Litharca* the hinder tooth is entirely wanting, the anterior tooth being like that of the true *Arca*.

The ligament is external, covering the area or *talus* between the umbones, formed by the gradual thickening of the cardinal edges, which causes the umbones to separate further and further from each other as the shell enlarges. The cartilage is situated in a series of small pits on the outer edge of the hinge-margin, these pits being moved forward as the shell increases in size, leaving grooves diverging from the apex of the umbo towards the margin of the shell; the grooves on the two valves forming a circumscribing series of concentric lozenge-shaped areas on the *talus*. In some genera, as *Senilia*, the grooves are complete and close together; in others, as the true *Arca*, the grooves of the young shell are complete; but as the shell increases in size, the grooves very often do not reach to the umbo, but look like a pair of lines regularly diverging from the hinge-margin.

In the first and second sections the cartilage in the very young shell forms a single triangular spot on the hinge-margin, just in a line with the umbo. As the shell increases in size and the hinge-margin extends, the cartilage divides in the centre, the separate parts gradually diverge from each other as the hinge-line extends, shelly matter being deposited between the parts, and a new piece of cartilage is deposited in the place where the other was formerly situated; at length this separates in half, like the former; and as the shell reaches mature age, there is a succession of angular lines placed concentrically one within the other, formed by the successive cartilage-pits, the youngest and smallest being in the centre.

In the first section, where the *talus* is large, by the rapidity of the enlargement of the hinge-margin, the cartilage-pits and grooves are far apart; and in the second, where the *talus* or area is smaller and less developed, they are nearer together and more evenly concentric. The grooves formed by the cartilage-pits are to be seen on the surface of the *talus* in the fossil species.

In some of the species of the third section the cartilage appears to occupy the whole length of the cardinal margin, and each new portion of cartilage and ligament deposited on the hinge-margin is rather longer than the one formerly deposited, so as to fit itself to the extended length of the hinge-margin.

There is no appearance of the angular lines found in the former section, and the cartilage or ligament, when it dries, splits into longitudinal filaments extended from one umbo to the other.

I. *The hinge-line linear, straight; the teeth divided into numerous, small, nearly equal-sized, transverse crests; the umbones separated by a broad lozenge-shaped area, with a series of distant grooves regularly diverging from the hinge-margin towards the umbo; margin of the shell entire, often gaping below. Periostraca paleaceous.*

1. *Litharca*, Gray, Syn. B. M. 1840, 155; 1844, 81. Shell wedge-shaped, closed beneath, obliquely truncated behind, elongated and rounded in front; umbo posterior; hinder hinge-tooth absent; anterior hinge-tooth very long, linear, divided into many equal plates; margin smooth. Periostraca paleaceous.

L. Lithodomus = *Byssarca* L., Sow.

Not having the animal, there is some difficulty in respect to the natural position of this shell. I have here regarded the short truncated end as the posterior, because I think I can observe the large oblong scar of the hinder pedal muscle under the inner margin of the truncated portion.

2. *Arca*, Gray, l. c. 155 = *Byssarca*, Swainson. Shell oblong, subquadrate, gaping beneath; hinge-margin rather produced at each end; umbo subanterior, curved; front cardinal tooth moderate, divided into small equal crests like the hinder one; the scar of the hinder pedal muscle very large, oblong, triangular, on the hinder half of the dorsal surface of the cavity of the shell. Periostraca paleaceous.

a. *Teeth small.* *Arca* Noë, *A. pacifica*, *A. truncata*, *A. navicularis*, *A. angulata*—if these presumed species are more than local varieties.

b. *Teeth larger.* *A. zebra*.

II. *The hinge-line broad, more or less curved; the teeth wider at the distal ends; the crest of the inner portion small, transverse, of the distal portion larger and more or less oblique or longitudinal; the umbones more or less separated by an elongate area, marked with angular concentric cartilage-grooves, or small, with slight cross-lines.*

A. Shell radiately striated or nearly smooth; lower margin entire or subdentate, sometimes gaping; cardinal teeth subequal; the umbonal area marked with angular concentric cartilage-grooves.

3. *Trisidus*, Oken; Gray, Syn. B. M. 1840, 155. Shell sub-

quadrangular, subequivalve, twisted; the left valve largest and more twisted, with the hinder slope more or less keeled; margin smooth or subcrenate; cardinal area narrow, grooved; cardinal teeth gradually broader at the distal end, and divided into large oblique plates. Periostraca palaceous, brown.

* *Hinder slope of left valve keeled.* T. tortuosa.

** *Hinder slope of left valve rounded.* T. semitorta.

4. *Barbatia*, Gray, Syn. B. M. 1840, 155. Shell oblong, longitudinal or subquadrate, equivalve; umbo subcentral; cardinal area narrow, angularly concentrically grooved; cardinal teeth curved, at the outer end dilated and divided into broad, more or less oblique or subconic plates. Periostraca palaceous, with more or less elongate, hair-like, or foliaceous projections.

a. *Periostraca thick, with elongate hair-like lobes in the radiating grooves, with a furrow along their upper edge; shell brown, solid.* B. fusca (Australian), B. barbata (Mediterranean).

b. *Periostraca thin, with slender hair-like filaments in the radiating grooves; shell thin, white.* B. parva.

c. *Periostraca palaceous, brown, with broad, flat, foliaceous lobes on the edge; shell thick, white.*

B. Helblingii = A. decussata = A. velata.

B. obliquata = A. Sincensis, B. fasciata.

B. lactea, B. raridentata, B. tenebrica.

B. glacialis.

d. *Periostraca thin* —; *shell white, cancellately ribbed or costated; hinder slope subcarinate.* Acar. B. reticulata, B. divaricata, B. gradata.

e. *Periostraca thin, smooth, with a series of triangular fan-shaped appendages in the radiating grooves; shell white; hinder slope strongly keeled; front and hinder margin dentated.* Calloarça. B. alternata.

The plates into which the cardinal teeth are divided differ considerably in specimens of the same species, not only in size and number, but also in form and direction; this is particularly the case with the specimens of *B. glacialis* from the Arctic Ocean, a species so distinct in form, substance, periostraca, and habitat, that there can be no difficulty in regarding all the varieties as belonging to the same species; yet it presents such variations in the form and character of the teeth, that one might be led, from only one or two specimens, to separate them into different subgenera. For in some the laminae of the outer end

of the cardinal teeth are transverse, like the inner ones; in others they are nearly longitudinal, like the teeth of *Cucullæa*; and in others again this part of the tooth is only divided into some irregular tubercles, or nearly obliterated.

I have observed the same variation, but not to such an extent, in other species; so that the form of the teeth does not afford generic nor even good specific characters.

5. *Cucullæa*, Lamk. Shell ventricose, subquadrate, subequilateral, equivalve, radiately striated; hinder slope subangular; margin entire, closed beneath; cardinal area narrow; the cardinal teeth dilated and bent down at the outer end, and divided into a few large longitudinal plates. The scar of the hinder adductor muscle on an elevated plate. Periostraca furfuraceous.

The cardinal area is smooth when the ligament and cartilage are removed, and the ligament appears smooth, but in some specimens I have observed two or three angular grooves.

Cucullæa concamerata = *C. auriculifera*, Lamk. = *A. cucullus*, Gmelin.

6. *Scaphula*, Benson (*Scaphura*, Gray, misprint). Shell thin, smooth, elongate, subcylindrical, equivalve, inequilateral; hinder slope elongate, slightly keeled; margin entire, closed; cardinal area narrow; hinge-teeth narrow, enlarged at the outer end, and divided into a few broad, oblique, nearly longitudinal laminæ. Periostraca thin, smooth.

Freshwater rivers of India.

Scaphula Celox, Bens., *S. Pinna*, Bens.

B. Shell radiately costated; lower margin strongly dentated, interlocking; the ligament and cartilage occupying the whole area, smooth or transversely striated.

A. Shell oblong, equivalve, subquadrate; cardinal teeth subequal.

7. *Senilia*, Gray, Syn. B. M. 1840, 155; 1844, 81 & 92. Shell very thick, subcordate, ovate, equilateral, equivalve, strongly radiately ribbed; cardinal area rather broad, with concentric grooves; margins closed, very broadly folded; hinge-teeth large, oblong, nearly similar, divided into large, rugose, irregular cross-plates. Periostraca thin, hard, olive, polished.

Living in brackish waters of Africa.

The teeth and the plates into which they are divided are very variable in shape, size, and disposition.

S. senilis.

8. *Anadara*, Gray, Proc. Zool. Soc. 1847, 198. Shell thick, subcordate-ovate or subquadrate, subequilateral, equivalved,

strongly radiately ribbed; margin closed, broadly folded; hinge-area broad, concentrically grooved or smooth; hinge-teeth oblong, dilated, and with the plates more or less oblique at the outer ends. Periostraca olive, smooth or paleaceous.

Marine, or in brackish water.

- a. *Periostraca* thick, black, smooth; hinge-area grooved. *A. grandis*.
- b. *Periostraca* thick, brown, velvety; hinge-area smooth.
A. holosericea. Hinder end produced.
A. multicostata, *A. globosa*. Hinder end square.
A. reversa. Hinder slope flattened.
- c. *Periostraca* thick, brown, velvet-like, with a series of cylindrical bristles in the radiating grooves; hinge-area smooth. *Cara*.
- * *Shell* produced behind; hinge-margin short. *A. Scapha* = *A. obliqua*, *A. maculosa*.
- ** *Shell* broad, notched behind; hinge-margin produced. *A. auriculata* = *avicularoides*.
- d. *Periostraca* thick, brown, foliaceous, with broad lobes on the edge. *Rasia*. *A. formosa*, *A. secticostata*, *A. Deshayesii*, *A. trapezia* = *lobata*, *A. antiquata*, *A. radiata*, *A. inflata*.
- e. *Periostraca* thick, or moderately thin, smooth, brown; ribs of shell nodulose. *A. tuberculosa*, *A. granosa*, *A. Corbicula* = *cuneata*.

9. *Scapharca*, Gray, Proc. Zool. Soc. 1847. Shell ovate or oblong, subquadrangular, subequilateral, inequivalved, strongly costate; margin closed, strongly plaited; left valve rather the largest, with the hinder part of the lower margin produced and receiving the edge of the right valve within it, and marked with deeper plaits; hinge-area narrow; teeth subequal, dilated, and with the plate of the outer ends more or less oblique or longitudinal.

- a. *Shell* subcordate. *S. cepoides*, *S. incongrua* = *rhomboidea* = *Brasiliana* = *ovata* = *rufescens* = *inæquivalvis*, *S. cornea* = *anomala*.
- b. *Shell* oblong-elongate. *S. Japonica* = *gubernaculum*.
- c. *Shell* subquadrate. *S. pertusa*.
- d. *Shell* trigonal, truncated behind; hinder hinge-tooth small, curved, anterior very long, linear.

10. *Noetia*, Gray, Syn. B. M. 1840, 155; 1844, 92. Shell

trigonal, ventricose, inequilateral, equivalve, strongly costated; hinder slope keeled; margin closed, strongly folded; umbo acute; cardinal area narrow, smooth; the anterior hinge-tooth elongated, divided into many subequal plates; the hinder tooth ovate, arched, small, of a few irregular laminæ. Periostraca dark, foliaceous.

1. *Noetia triangularis*, n. s.

c. *Shell subcordate, inequivalve; anterior cardinal tooth very small.*

11. *Argina*, Gray, Syn. B. M. 1840, 155; 1844, 81 & 91. Shell subglobose, subcordate, subequivalve, inequilateral, strongly radiately costate; umbo subanterior; lunule none; left valve rather the largest, with the hinder part of the lower margin dilated and more deeply folded; hinge-area narrow, smooth; hinder cardinal tooth elongated, curved, the central crest small. Periostraca brown, foliaceous, with flat conical laminæ in the radiating grooves.

a. *Shell subglobose.* A. pexata.

b. *Shell oblong, elongated.* A. Campechensis = A. Americana = transversa = compacta, A. pectinoides, King = labiata, A. brevifrons.

12. *Lunarca*, Gray, Syn. B. M. 1844, 81. Shell globose, subcordiform, radiately costated, nearly equivalve; umbo subanterior; lunule distinct, compresso-cordate; the lower hinder margin of the left valve rather the most deeply dentated; hinder cardinal tooth elongate, narrow in the middle, rather wider at each end; the front tooth of the left valve ovate, elevated, entire, fitting into a cavity in the inner edge of the front margin of the right valve.

It is possible that this may be only a monstrosity of *Argina pexata*, as I have observed that the teeth, especially the small anterior one, of this species are very apt to vary; but I have not seen any bearing a strong resemblance to the specimen on which this genus was founded; therefore I have retained it until we receive more specimens to elucidate the subject.

L. costata.

Tribe 2. PECTUNCULINA, Gray, Ann. & Mag. N. H. xiii. 417.

I. *The hinge-facet with a broad triangular impression occupied by the ligament, and with the cartilage in angular concentric grooves.*

13. *Axinea* = *Pectunculus*, Lamk. Shell suborbicular, rounded

or rather angularly produced behind; margin crenulated. Periostraca velvety.

- a. Shell smooth, ventricose; hinder slope rather angular. *A. violascens*.
- b. Shell smooth, rounded behind; periostraca velvety. *A. pilosa*, *A. Glycimeris*.
- c. Shell smooth, rather angularly produced behind. *A. pennaecus*, *A. angulatus*, *A. longior*, *A. obliquus*.
- d. Shell subcostate, rather angularly produced behind. *A. radiatus*.
- e. Shell subcostate, short behind. *A. ovatus*, *A. laticostatus*.
- f. Shell radiately ribbed, slightly truncate behind. *A. pectiniformis*.
- g. Shell irregularly ribbed and radiately striate. *A. inæqualis*.

II. Cardinal area small, with a smaller triangular central impression for the cartilage (like the cartilage-pit of *Lima*) just under the umbo and above the division between the teeth.

14. *Limopsis*. Shell circular, compressed, solid, radiately striate. Periostraca —? *L. multistriatus*.

15. *Limæa*. Shell ovate, obliquely produced behind. Periostraca hairy. *L. pygmaea* = *Limæa Sarsii*, Lovén. *L.* —? (Belcher).

The fossil *Limæa scalaris*, of Barton Cliff, is somewhat intermediate in form between these two genera.

XXVIII.—On a New Species of Macgillivrayia. By ARTHUR ADAMS, S.R.N., F.L.S. &c.

To the Editors of the Annals of Natural History.

On the Line, January 7, 1857.

GENTLEMEN,

I have the pleasure of sending you a notice of a new *Macgillivrayia*, the same species alluded to in p. 89, vol. ii. of the 'Genera of Recent Mollusca,' but there erroneously referred to the genus *Calcarella*. Associated with my *M. echinata* were examples of *Brownia*, another small genus of pelagian Mollusks, first named by D'Orbigny, and called afterwards *Echinospira* by Krohn, *Calcarella* by Souleyet, and *Jasonilla* by Macdonald, the animal of which was not observed. An example, likewise, of a

peculiar form, named by Dr. Gould *Agadina cucullata*, which seems to belong to the family *Limacinidae*, was taken in the towing-net during the passage of H.M.S. 'Actæon' across the North Atlantic, besides numerous interesting oceanic Crustaceans, including the genera *Lucifer*, *Hyperia*, *Phyllosoma*, *Amphion*, *Oxycephalus*, *Alima*, and *Pontia*.

I am, Gentlemen,

Yours very truly,

ARTHUR ADAMS.

Macgillivrayia echinata, A. Adams.

M. testa cornea, diaphana, subglobosa, lævi, nitida; anfractibus $2\frac{1}{2}$ serie spinarum acutarum vitrearum armatis; apertura semiovata; labio antice producto, in spinam acutam desinente.

Hab. in Oceano Atlantico Boreali.

Shell horny, pellucid, subglobose, smooth, shining; whorls $2\frac{1}{2}$, with a series of long, sharp, vitreous spines round the periphery, directed upwards and outwards. Aperture semioval; columellar lip produced anteriorly into a long pointed spine. Operculum annular, with the nucleus subcentral.

Taken in the towing-net in the vicinity of the Cape de Verd Islands.

This species differs from all the others known by the whorls being armed with a series of recurved calcareous spines.

XXIX.—*Descriptions of new Ceylon Coleoptera.*

By JOHN NIETNER, Colombo, Ceylon.

[Continued from p. 249.]

Anchista, n. g., N.

Corpus depressum, ovatum. Mentum dente magno obtuso, lobis parum brevior, his extus rotundatis, apice acuminatis. Palpi robusti, maxillares art. ultimo magno ovato, apice obtuso, labiales art. ultimo valde securiformi. Ligula cornea apice obtuse acuminata, labri marginem anteriorem attingens. (Paraglossæ a me non dissectæ.) Labrum transversim quadratum. Mandibulæ simplices apice arcuatæ et acuminatæ. Antennæ robustæ art. 1^o mediocri, 2^o brevi, 3^o quarto paulo longiore, 4–10 subæqualibus, 11^o penultimo parum longiore. Thorax longitudine latior, angulis anticis rotundatis, medio obsolete angulatus, basi angustatus, angulis rectis. Elytra apice quadrate truncata. Pedes robusti, tarsi art. 4^o profunde bilobato, ungulibus fortiter postinatis.

12. *Anchista modesta*, N.

A. brunneo-testacea, elytris (maculis 2 obsoletis subhumeralibus exceptis) obscurioribus, abdomine piceo. Long. corp. 4 lin.

Caput fronte medio leviter uniimpressa. Thorax linea media longitudinali divisus. Elytra apicem versus parum dilatata, striatopunctata, ad striam 2^m punctis 2 majoribus subapicalibus, cum thorace marginata.

Prope Colombo nocte ad lumen cepi.

The characteristics of this new genus are those of *Calleida* (between which and *Cymindis* I place it) excepting the ligula, which in this case is obtusely acuminate; the last joint of the maxillary palpi, which is obtuse at the apex; and the thorax, which is not, as in *Calleida*, longer than broad, but the reverse. From *Cymindis* it would differ principally in the deeply bilobed fourth tarsal joint, and in some other minor points; but it is difficult to say what the true characteristics of this genus (which appears for this reason to require a careful revision) are, if even Lacordaire uses the particle "on" not less than five times in the diagnosis he gives of it in his 'Genres des Coléopt.' However, I feel justified in separating *Anchista* from *Cymindis* as well as from *Calleida*. The name "*Anchista*" has reference to the affinity of the insect to the two genera just mentioned, whilst the specific name "*modesta*" refers to its inconspicuous colours. Amongst its peculiarities, weight ought to be laid upon the plumpness of the palpi, and in fact on all the other parts of the mouth, and even the whole head, which was very striking to me.

Like many of my best Carabidæ, I found this insect at night on the table, whither it had been attracted by the light. I may mention that the single specimen which came thus into my possession has an oblong shallow impression on either elytron,—perhaps accidental, perhaps a peculiarity. The anterior tarsi are dilated and furnished with hairy brushes below, longest at the apex of the lobes of the fourth joint.

Elliotia, n. g., N.

Corpus subconvexum, ovatum. Caput mediocre, oculis maximis. Mentum leviter transversim emarginatum, edentatum, lobis acuminatis. Ligula submembranacea apice truncata, paraglossis connatis marginem anteriorem parum superantibus, obtusis. Palpi elongati, art. ultimo elliptico, acuminato. Labrum magnum transversum, integrum, mandibulas fere obtegens. Mandibulæ validæ, edentatæ. Antennæ robustæ filiformes, humeros superantes, art. 1^o mediocri, 2^o brevi, 3^o quinti prope longitudine, 4^o præcedente brevior, 2-4 obconicis, 5-10 æqualibus, cylindricis, 11^o præcedente tertia parte longiore, 4-11 pilosis. Thorax parvus, capite minor, transversus,

longitudine duplo lator; antice leviter emarginatus, lateribus elevato-marginatus, ab apice ad medium lateribus rotundatus, medio fortiter angulatus, a medio ad basin valde abrupteque angustatus, basi truncatus, subtus cylindricus. Scutellum leviter excavatum. Elytra ovata marginata, apice sat fortiter truncata. Pedes omnes subaequales, simplices, tenues, tarsi cylindrici art. 3-4 magis minusve trigonis, unguitibus simplicibus. Prosternum carinatum.

In honorem Dom. Hon. Walteri Elliotti (Maderaspalani), naturalistae diligentissimi, meritissimi, nomen imposui.

13. *Elliotia pallipes*, N.

E. supra nigra, nitida, thorace scutelloque rufo-testaceis, labro elytrorumque limbo atque sutura brunneo-testaceis; subtus picea, pectore rufo-testaceo, pedibus albidis, geniculis oreque (palpis obscurioribus exceptis) testaceis. Long. corp. $2\frac{1}{2}$ lin.

Caput ad antennarum insertionem et inter oculos utrinque profunde impressum. Thorax basi rugosus, ante medium utrinque uniimpressus, linea media longitudinali divisus. Elytra punctatostriata, infra humeros leviter impressa.

In ripis lacus Colombensis sub veget. putrescent. mens. Jul. non infrequenter legi. Agilis est et avolare semper expeditus.

A pretty and very interesting little insect, about whose systematic position I am not quite satisfied; however, I provisionally place it towards the end of the true Lebiidae. I find it most to agree with the descriptions of *Pentagonica*, S. G., and *Rhombodera*, R., with neither of which, however, it is identical. The head is distinguished by the large and prominent eyes, and four deep impressions, two larger ones at the root of the antennae, two smaller ones between the eyes, also by a very distinct neck, which connects it with the thorax; the labrum is large, transverse and entire, with the angles rounded off and the base narrowed; the mentum is but slightly transversely emarginate, edentate; the ligula is truncated at the tip, the paraglossae adhere to it, reach a little beyond it, and are obtuse at the apex; the palpi are rather long, with the last joint elliptic, acuminate; the antennae are strong, filiform, and reach beyond the shoulders, joints 5-10 are of equal length and cylindric, 4-11 are pilose. The most remarkable part of the insect is, however, the thorax, which is of a subrhomboidal shape, transverse, smaller than the head, as broad again as long; it has two strong, lateral angles at the middle, each furnished with a strong bristle; the anterior part has the sides rounded, the posterior abruptly obliquely contracted; at the base it is cylindric. As a specific distinction of the thorax, I mention, moreover, that in the present species it is impressed with two deep punctures before the middle, and that it is rugose at the base. The abdomen is slightly peduncled,

The scutellum is slightly excavated. The elytra are oval, rather convex, and impressed with rows of punctures. The legs are simple and weak, apparently equal in both sexes. The anterior tarsi are a little stouter than the rest, but not dilated nor furnished with any additional clothing below; the anterior tibiæ are deeply notched. As to the colour: the head and wing-covers are black, the latter with the suture and margin of a light brown, and highly polished; the thorax is reddish, and the legs are whitish. The insect is very agile, and ever ready to take to its wings. It is of quite a peculiar appearance, imparted to it by its large eyes, small, curiously-shaped thorax, and rather plump elytra and abdomen. I may further mention that I have observed the fourth joint of the maxillary palpi collapse when the specimens become quite dry, so as to give them a different, spoon-like appearance, apt to mislead any one who has not examined fresh specimens.

14. *Harpalus advolans*, N.

H. æneus, clypeo, labro, antennis mandibulisque brunneis, his apice nigris, subtus testaceus, lateribus obscurior, pedibus flavis, tarsis, geniculis spinulisque brunneis, ore testaceo. Long. corp. $4\frac{3}{4}$ – $5\frac{1}{2}$ lin.

Caput læve. Mandibulæ unidentatæ. Palpi art. ultimo elongato, apice truncato. Menti dens simplex, obtusus. Ligula apice quadrate truncata, angulis acutis leviter productis, paraglossis inflatis marginem anticum parum superantibus. Thorax longitudine sesquialior, dorso anticeque lævis, basi rugoso-punctatus, 2-impressus. Elytra striata, cum thorace anguste marginata. Variat colore testaceo-ænea.

Nocte ad lumen, sed ad huc non usquam alibi, non infrequenter cepi.

I have taken this species frequently at night on my table, but never found it as yet anywhere else. It is not very distinguished, for which reason I have mentioned the parts of the mouth in the description, these being, moreover, not very constant in this genus. The insect is of the usual oval *Harpalus*-form, of a dark metallic green on the back, and more or less yellowish or light brown below, the colour of the back changing occasionally to a brownish green.

15. *Oodes piceus*, N.

O. ovatus, subconvexus, piceus, tarsis, palpis antennarumque articulis 3 primis castaneis, palpis apice flavis. Long. corp. 4 lin.

Caput parvum, inter antennis linea latitudinali abbreviata impressum. Labrum integrum, punctis 3 impressum, puncto intermedio bi-, lateralibus uni-setigeri. Mandibulæ validæ prominentes. Palpi art. ultimo elongato-ovato, apice leviter truncato. Menti dens apice

truncatus leviterque sinuatus. Antennæ art. 3^o quarto æquali nisi paulo brevior. Thorax amplius basi elytris applicatus, apicem versus angustatus, angulis posterioribus subdepressis translucens, ante scutellum leviter sinuosus, ante sinum obsolete latitudinaliter impressus. Elytra striata, cum thorace angustissime marginata. Pedes validi, ant. tibiis apice intus uni-, intermed. et post. bi-calcaratis.

Specimen singulum f. in ripis lacus Colombensis sub. vegetab. putrescent. legi.

As one species with a bifid mentum-tooth (*O. pulcher*) has been already received into this genus, I have waived the hesitation I should otherwise have felt in referring to it the present one, the tooth of which is of a similar description. I have not seen the *O. pulcher*; but, as it is said to be an inhabitant of this part of the world, it may possibly be identical with my species. If not, they might, as the genus is otherwise pretty constant in its characteristics, be separated under a new name as types peculiar to India. Besides the abnormal mentum-tooth, the insect has not much to distinguish it from others of the genus. The labrum is, however, peculiar, being entire, or even very slightly produced in the middle, with the angles rounded off; it is impressed near the anterior margin with three deep punctures, the central one of which is furnished with two, the lateral ones with one strong bristle each. The anterior tibiae are but slightly notched. The prosternum is largely developed, reaching beyond the anterior coxae, obtusely acuminate, and received in a deep excavation of the mesothorax. But I doubt whether the development is sufficiently large to entitle the insect to a place in *Lonchosternus*, Laf., which, however, I have not seen.

16. *Trichopteryx cursitans*, N.

T. ovata, subconvexa, pubescens, supra obscure ænea, elytris æneobrunneis, subtus picea, pedibus oreque testaceis, antennis art. 3-11 nigrescentibus. Long. corp. $\frac{3}{4}$ lin.

Antennarum clava art. 2 primis ovatis, ultimo conico, acuminato. Thorax amplissimus, elytris tertia parte minor, convexus, angulis acutis, basi humeros amplexans, apice angustatus. Elytra subdepressa, subquadrata, apicem versus parum angustata, truncata, abdominis 3-4 segmenta ultima non obtegentia. Tibiis medio incrassatis. Coxæ posticæ maxime dilatatæ. Mesosternum carinatum.

Sub veget. putrescent. exsiccantibus in prov. occid. copiosa.

A rather large species, commonly met with in this part of the island, under rotting vegetable substances somewhat dried up. It is very agile, and ready to take to its wings, which are of the beautiful typical construction, about twice the length of the body, and, in dead specimens, frequently produced behind. These insects vary a little as to shape, some being more narrowed

behind than others, and also as to the exact number of the abdominal segments left uncovered by the elytra. The head is large, but exhibits nothing abnormal or extraordinary; the thorax is very large, emarginated in front and behind, with the angles acute, the basal ones enveloping the shoulders; the wing-covers are subquadratic, with the angles rounded off and a little narrowed behind; the legs have the tibiæ incrassated in the middle, and the posterior coxæ very much dilated and distant from each other; in all other respects they are typical. The shape of the body is that of an egg, broadest at the shoulders, gently narrowed towards the apex of the abdomen, and rounded off towards the head.

17. *Trichopteryx immatura*, N.

T. præcedenti similis, differt tamen colore: supra seneo-testacea, subtus testacea, antennarum art. 3-11 nigrescentibus; differt etiam corpore crassiore, magis quadrato, capite paulo majore, thorace minus convexo, parum ampliore, clytris abdomen totum vel fere totum obtegentibus. Pedes, antennæ &c. omnino præcedentis. Long. corp. $\frac{1}{4}$ lin.

In præcedentis societate specimina nonnulla legi.

Somewhat resembling in aspect an immature individual of the former, but sufficiently distinct to be formed into a new species. The insect is altogether of a different appearance, imparted to it by the greater general plumpness of the body, the larger head, the less convex, but at the same time possibly still ampler thorax, the altogether more quadratic shape, &c. The remark regarding the exact number of abdominal segments left uncovered by the elytra applies to this and all other species as well. The present one has generally the last two segments uncovered.

18. *Trichopteryx invisibilis*, N.

T. ovata, subdepressa, subparallela, pilosa, supra obscure senea, subtus picea, pedibus, abdomine, antennis oreque testaceis. Long. corp. vix. $\frac{1}{4}$ lin.

Thorax amplius, clytris sesqui minor, convexus, angulis posticis humeros vix superantibus. Elytra oblonge quadrata angulis rotundatis, subdepressa, truncata, abdomen totum vel fere totum obtegentia. Coxæ posticæ approximatae. Tarsi typicis minus elongati, art. 3^o præcedentibus haud multo longiore.

Cum *T. currentante* victitat; frequenter legi.

A very pretty and very distinguished species. Its most striking peculiarity consists in the posterior coxæ, which are as little distant from each other as those of the anterior legs, and almost touch each other, and also in the shortness of the tarsi. The

head with the antennæ, the mesosternum, the tibiæ, which are incrassated in the middle, and the posterior coxæ with regard to their enlargement, are quite typical. However, the thorax and elytra differ again from those of *T. cursitans* (which, in every respect, may be looked upon as the typical representative of the family in Ceylon, and which is here referred to as such), the former by the shortness of the posterior angles, which can hardly be said to envelope the shoulders; the elytra, by being less or not at all narrowed behind, giving an oblong rather than an oval shape to the insect. Although in length only about one-half shorter, it is in bulk certainly one-fourth smaller than *T. cursitans*; and, although probably the smallest Ceylon beetle, it is distinguished at first sight.

19. *Ptilium subquadratum*, N.

P. subquadratum, subconvexum, pilosum, obscure æneo-testaceum, thorace dilutior. Long. corp. $\frac{1}{4}$ lin.

Caput mediocre. Antennarum clava art. 1^o invertè conico, 2^o subcylindrico, ultimo elongato-ovato. Thorax convexus, angulis basalibus humeros fortissime amplectentibus, apicem versus valde rotundatus, apice leviter sinuatus. Elytra quadrata, abdomen non totum obtegentia. Scutellum parvum. Pedes robusti tibiis apicem versus incrassatis, tarsis art. 3^o primi secundique longitudine, his subbilobatis subtus penicillatis, coxis posticis simplicibus distantibus. Mesosternum non carinatum.

Ubi præcedentes sed infrequenter occurrit.

The genus *Ptilium* is the repository for all the anomalies of the family; its characteristics, therefore, are very vague; but if the absence of the mesosternal carina and the simplicity of the posterior coxæ are the determining features amongst them, the present species, in spite of a variety of anomalies it exhibits in other respects, belongs to it. The head is of middling size; the antennæ robust, with the first joint of the club of the shape of an inverted cone, the second rather cylindrical, narrowed at the base, and the last elongate, ovate. The thorax is of very different structure from that of the foregoing species of the family, the basal angles being produced unusually far beyond the shoulders; towards the head it is strongly and rapidly rounded off, being thus altogether of a semicircular shape; at the apex it is merely slightly sinuated, and the head is inserted rather below than in this sinuosity; the whole thorax, moreover, is very convex, whilst the elytra are depressed. The wings vary from the typical form by being fringed with short, simple cilia instead of the long, feathery appendages; they are, moreover, without a distinct peduncle, but still folded in the manner characteristic of the family.

The legs are stout, with the tibiæ thickest at the tip; the third tarsal joint is of the length of the preceding two, the latter are somewhat bilobed and hairy below. The posterior coxæ are simple and distant. The mesosternum without a carina. The whole shape of the insect is quadratic rather than otherwise.

20. *Ptenidium macrocephalum*, N.

P. ellipticum, subconvexum, nitidum, sparsim pilosum, supra piceo-seneum, subtus piceum, pedibus oreque testaceis. Long. corp. $\frac{1}{2}$ lin.

Caput maximum. Antennarum clava elongata articulis ellipticis. Thorax subquadratus antice posticeque angustatus, basi punctis 4 magnis profunde impressus. Elytra ovata, medium versus leviter inflata, apice obtuse acuminata, abdomine longiora et ampliora, punctulis lineis dispositis obsoletissime impressa. Alæ corpore plus duplo longiores. Tibiæ fortiores spinulosæ. Tarsi breviores. Prosternum carinatum.

In præcedentium societate frequenter lectum.

This is perhaps the prettiest of the five species of the family just described, and at first sight recognized by the shape of its body and the polished back. The head is very large. The thorax is narrowed in front and behind, at the latter place impressed with four deep punctures, which cannot be overlooked. The wing-covers are oval, a little inflated about the middle, rounded at the apex, and longer and wider than the abdomen. The prosternum is carinated.

It affords me much gratification to be enabled to publish representatives of three genera of this highly interesting and probably very extensive and widely distributed family of pigmies, the Asiatic representatives of which have hitherto been entirely unknown. I have no doubt that even this island is the abode of a great many more species.

21. *Stenus barbatus*, N.

S. elongatus, seneo-niger, nitidus, punctatus, sparsim pubescens, pedibus palisque albidis, ore coxisque testaceis, antennis brunnescentibus. Long. corp. $2\frac{1}{2}$ lin.

Caput thorace tertia parte latius, fronte costis 3 abbreviatis, antice albido-pubescens. Antennæ art. 3^o sequentium 2 fere longitudine, 3 ultimis elongatis, ellipticis. Palpi max. elongati apice densius pubescentes. Thorax cylindricus medio leviter incrassatus, basi subquadratus. Elytra thorace paulo longiora, sed fere duplo latiora, convexa, ovata. Abdomen immarginatum. Pedes elongati tennes, tibiis apice tarsisque fortiter setosis, his art. 4^o profunde bilobato.

In lacus Colomb. ripis specimina nonnulla legi.

This, as well as the following species, belongs to Erichson's

division II. B. of the genus, both having the abdomen immarginate and the fourth tarsal joint bilobed. Everything about this species is elongated. The head is about one-third broader than the thorax; the forehead is slightly excavated, with two elevated ridges running from the root of the antennæ a short distance upwards; a third runs from the crown of the head down towards the centre of the two former, but all three reach only about the middle of the head. The part below the antennæ is covered with white hair. The antennæ have the third joint much elongated, and the terminal club composed of elliptic joints. The thorax is rather slender, incrassated at the middle, gradually narrowed in front, but nearly quadratic behind. The elytra are longer than the thorax, about double its breadth, and oval, being slightly narrowed at the shoulders and the apex. The legs are long and slender, hairy at the apex of the tibiæ and the tarsi, the latter very much so on the inner side. The insect is of a metallic black colour, highly polished; the legs, palpi, and the first two antennal joints are whitish, the tibiæ and the apex of the palpi being, however, rather darker; joints 8-11 of the antennæ are brownish; the coxæ and the mouth are yellowish; the tarsi have a brown spot at the apex of the first three joints; the claws are black. The insect is punctured all over, but less so on the abdomen, the apical segments of which are indeed nearly smooth, than elsewhere, and sparingly covered with small white hairs.

22. *Stenus lacertoides*, N.

S. robustus, nigro-ceneus, dense profundeque punctatus, subtus sparsissime pubescens, pedibus palpisque testaceis, femoribus apice nigrescentibus, antennis oreque castaneis. Long. corp. $1\frac{1}{2}$ lin.

Caput thorace quarta parte latius, fronte 2-costata. Antennæ robustæ art. 3^o quarto paulo longiore, 9-10 globosis, 11^o conico. Thorax cylindricus, medio fortius incrassatus, latitudine quarta parte longior, margine anteriore elevato, basi subquadratus. Elytra thorace longiora, convexa, humeris prominentibus. Abdomen immarginatum. Tarsi art. 4^o profunde bilobato.

In prov. occid. stagnorum ripis rarius occurrit.

About this species everything is robust. It is well distinguished by the rounded club-joints of the antennæ, the elevated anterior margin of the thorax, the prominent shoulders, and its general shortness and plumpness. The forehead is rather more depressed or excavated than in the former, the two antennal ridges are shorter, the vertical one is altogether obsolete. The palpi are robust. The third antennal joint is about one-third longer than the fourth. The thorax is shorter and plumper than in the former. The elytra are less oval, having the shoulders

more prominent, and only the apex rounded-off or narrowed. The legs are similar to those of the former, but more robust, less hairy, and have the tarsi more cylindric. The insect is of a blackish metallic colour; the legs and palpi are yellowish; the tibiæ, however, the apex of the palpi, and also joints 1-2 of the antennæ are rather darker; the femora are blackish towards the end; the mouth and joints 3-11 of the antennæ are chestnut, and the coxæ pitch-colour. The animal is densely and deeply punctured all over, very sparingly covered with small greyish hairs, nearly obsolete on the back, but more distinct below. It is less highly polished than the former. I have known this species for a long time, and specimens of it must exist at the Mus. Berol.; the former I met with but lately.

I may mention, that in dissecting these two species I have observed the same remarkable production of the œsophagus with the ligula, characteristic of the genus, and noticed in many of the European kinds.

23. *Anthicus formicarius*, N.

A. castaneus, capite, abdomine elytrisq. piceis, his pilorum niveorum fascia media transversali interrupta maculisq. concoloribus 6 humeralibus, obsolete, parce pilosus. Long. corp. $1\frac{1}{2}$ lin.

Caput globosum supra subtusq. profunde punctatum, oculis parvis. Thorax nodoso-pyriformis, infra medium constrictus, parte anteriore crassiore lin. long. med. profunde divisa subcordiformi. Elytra elliptica.

Sub veget. putrescent. vicitat; prope Colombo rarius legi.

This insect looks uncommonly like an ant. It is easily distinguished from all other species of the island partly by this resemblance, partly by the sculpture of the thorax and the white fascia across the elytra. The antennæ are robust, thickened towards the tip, the three last joints forming a club. The legs have the femora very much incrassated, the tibiæ at the apex bicalcarate and the tarsi, especially of the anterior pair, very hairy below; the fourth joint appears to be slightly cordiform. The white marks of the shoulders and the fascia across the wing-covers are composed of white hairs; the former are rather an interrupted row of these than true maculæ; the fascia consists of two halves, one in either elytron, reaching neither the external margin nor the suture. The insect is of slow motion.

24. *Anthicus insularis*.

A. testaceus, abdomine obscuriore, capite thoraceq. rufo-testaceis, elytris fasciis 2 nigris, parce pilosus. Long. corp. $1\frac{1}{2}$ - $1\frac{1}{4}$ lin.

Caput globosum, oculis mediocribus. Thorax pyriformis, cum capite supra punctatus. Elytra ovata. Tarsi art. 4^o bilobato.

Prope Negombo in pratis sat copiosus.

In some of the specimens before me the anterior femora are furnished with a strong spine inside, having at the same time the tibiæ of the same pair of legs slightly emarginated inside near the apex. I have reason to believe these individuals, if the distinction be a sexual one, to be females, not males.

25. *Meligethes orientalis*, N.

M. ovatus, subconvexus, pilosus, supra nigro-æneus, subtus piceus, pedibus, antennis palpisque maxill. dilutioribus, tarsis palpisque labial. brunneo-aureis. Long. corp. 1-1½ lin.

Mentum transversum planum, punctatum, lobis apice depressis, excavatis, glabris, obtusis. Palpi lab. art. ultimo inflato, ovato; maxill. art. ultimo apice angustato levissime truncato. Mandibulæ unidentatæ. Thorax amplus angulis acutis, antice emarginatus, postice pluries sinuatus, subtus punctatus. Elytra ovato-quadrata, angulis 4 apicalibus rotundatis, pygidium haud obtegentia. Pedes validi, femoribus tibiisque incrassatis; anteriores tibiis apice intus unispinosi, tarsis art. 1-3 fortiter dilatatis, 1-2 subæqualibus transversis, profunde reniformibus, 3^o minore, cordato, 4^o minimo, subcylindrico; intermed. et post. tibiis extus spinulosis, tarsis anterioribus similibus sed art. 1-3 minus dilatatis, cordiformibus. Prosternum marginatum, punctatum, obtuse acuminatum. Mesosternum antice carinatum.

Variat magnitudine et colore æneo-brunneo.

Prope Colombo in floribus per occasionem frequentissime legi.

Of the usual shape and colour, but larger than usual, varying, however, in this respect, some individuals being fully one-third smaller than others. These small individuals, which occur in the proportion of about 1 to 20, are, moreover, nearly always of a brownish metal colour, instead of a blackish green. I have been unable to discover any other distinctions. I was much interested by the discovery of these insects, having missed them for years amongst the abundantly represented *Nitidulidæ* of the island. They appear to be of local occurrence, or attached to certain plants, which is nearly the same. I find them in abundance in the beautiful bell-shaped blossoms of the *Argyrea argentea* and one or two other plants in my garden. The species appears to differ from the typical *Meligethes* in the following points:—the structure of the mentum, which I have sufficiently described above; the last joint of the labial palpi, which in this case is not truncated; and the first of the antennæ, which is externally incrassated, as in *Epuræa*. The antennæ are otherwise robust, the club is firm

and hairy. The thorax is very ample, thinly ciliated along the upper part of the anterior margin, rather strongly below. The prosternum is largely developed, marginated, punctured, and obtusely acuminate, overlapping the anterior part of the mesosternum, which (the anterior part) is cylindric and carinated. Joints 1-3 of the tarsi are strongly penicillated below, the penicilla being composed of glanduliferous hairs of a fine golden colour.

26. *Georyssus gemma*, N.

G. pygmaei statura et magnitudine, supra purpureo-aeneus, iridescens, subtus piceus; *alatus*. Thorax subsemiorbicularis infra apicem constrictus, sulco med. long. divisus, lateribus, basi apiceque excavatus, impressionibus 3 majoribus dorsalibus, 2 minoribus lateralibus. Elytra fortissime costata, costis obtuse dentatis, in interstitiis transversim punctato-impressa, ad humeros profunde excavata, infra medium leviter sinuata. Tibiæ extus spinulosæ, intus sparsim ciliatæ.

In prov. central. montibus Kotmaliensibus alt. 3500 ped. in rivulorum ripis non infrequenter legi.

Lacordaire and others characterize *Georyssus* as having the elytra soldered together, and being destitute of wings. *In the present species, however, the elytra are unconnected, and wing-covers proportionately larger than in any other beetle I can at present think of.* They are elongated and comparatively narrow, resembling in shape very much those of a *Libellula*, have a few veins at the base, and are ciliated at the margin. I have, moreover, occasionally taken insects of this genus *flying* about the light at night, but I am not quite sure at present whether it was this or any other species. The sculpture of the thorax is complicated and difficult to describe; however, the leading features in it are these:—a subapical sinuosity on either side; a longitudinal furrow; excavated sides, base and apex; three larger dorsal depressions (one central, two obliquely basal), and two smaller lateral ones at the subapical sinuosities, a short elevated ridge at the centre of the base separating the two basal impressions, and being itself divided by the longitudinal furrow; two elevations separating the anterior part of the basal impressions from that of the central one (at the middle these three depressions are connected); two small rugosities near the anterior margin, one on either side of the longitudinal furrow.

The sculpture of the elytra is less complicated: they have a deep cavity at the shoulder, a large but not deep sinuosity below the middle, and are obtusely acuminate. The costæ of the back are eleven in number, the suture lying in the central one.

The half of this central costa and the exterior margin form an elevated border round either elytron. The first and second on either side run towards the apex, but come to a stop (very abrupt in most, but less so in some, specimens) before reaching it; the third, after having been interrupted near its base by the sub-humeral cavity, runs on, but does not reach as far as the former; the fourth does not leave the region of the shoulder; the last on either side is very prominent at the base, but soon forms an abrupt declivity, and runs on as a low ridge to below the middle. The back of all these costæ is obtusely dentated. The interstices are marked with large, shallow, transverse impressions. The head of the insect is rather large and even. The mandibles are furnished with an obtuse subapical tooth, the two lower thirds are ciliated. The maxillæ have the apex of the outer lobe externally enlarged, rounded-off, and furnished with three strong teeth replaced by cilia on the inside; the inner lobe is conic, and similarly provided with teeth and cilia, but much thinner and finer. The maxillary palpi are robust, the last joint is inflated at the base. The antennal club is hairy, dark (whilst the remaining joints are yellowish), conic, and somewhat securiform, the sixth joint being inserted on one side of the seventh. The legs are robust, the tibiæ slightly curved, obliquely truncated at the end, furnished with spines along the outside, and with distant cilia along the inner.

27. *Hydrochus lacustris*, N.

H. elongatus, subdepressus, supra metallicus, iridescent, subtus piceus, pedibus, antennis, palpis elytrorumque margine magis minusve brunneis, mento cyaneo. Long. corp. m. 1 lin., f. multo major atque robustior.

Palpi maxill. robusti art. ultimo elliptico leviter inflato. Mandibulæ apice bifidæ. Antennarum clava dense pilosa. Thorax oblonge quadratus, basin versus angustatus, basi medio productus, cum capite profunde punctatus. Elytra ad humeros oblique truncata, apicem versus sat fortiter angustata, profunde striato-punctata. Tibiæ extus spinulosæ.

Specimina nonnulla in lacu Colomb. legi.

The head is robust, broader than the thorax; the eyes large and prominent.

The femora, the last joint of the maxillary palpi, the mandibles and the tarsal joints are dark towards the apex. The last abdominal segment of the female is furnished with a bifid hairy appendage.

28. *Hydrous rufiventris*, N.

H. ovatus, convexus, supra oleagino-niger, subtus obscure ferrugineus, pedibus dilute piceis, labro æneo, reliquis oris partibus cum clypeo testaceis. Long. corp. 8 lin.

Palpi maxill. articulis apicem versus abruptius incrassatis, art. 3° quarto sesqui longiore. Antennæ art. 7-8 fortiter perfoliatis, ultimo acuminato. Caput antice utrinque punctulorum serie subsemicirculari et ad oculorum marginem interiorem impressum. Thorax punctulorum seriebus 4 lateralibus, 2 subapicalibus obliquis abbreviatis signatus. Elytra subtiliter striato-punctata. Tarsi omnes unguibus basi fortiter unidentatis. Carina prosternalis cultriformis.

Specimen singulum f. nocte ad lumen cepi.

As far as my resources allow me to ascertain, a very anomalous species, having the perfoliated antennæ and toothed claws of a *Hydrophilus* and the cultriform prosternal carina and the elytra of a *Hydrous*. I have placed it in the latter genus on account of the sharp edge of the prosternal carina, in which the great distinguishing character of this genus seems to lie, this part being deeply grooved in *Hydrophilus*.

The insect at once attracts attention by the reddish colour of its abdomen. It is of a blackish olive-colour on the back, having, however, the clypeus and the anterior margin of the labrum of a yellowish brown, the latter being otherwise of a rather metallic colour. The remaining parts of the mouth are more or less yellowish. Joints 1-6 of the antennæ are yellowish too, with the exception of the second, which is dark; joints 7-9 are blackish and pubescent. The legs are of a light pitch-colour. The lower part of the head is impressed with two rather semicircular series of punctures, similar punctures occurring along the internal margin of the eyes. The thorax is marked with six series of them, and on the elytra they are arranged in lines. The sternal carina is well developed, the prosternal part has a sharp edge, whilst the mesosternal one is obtuse on the back, and the metasternal part depressed and slightly grooved.

29. *Hydrous inconspicuus*, N.

H. præcedente minus convexus, supra oleagino-niger, subtus rufopiceus, ore testaceo. Long. corp. 4½ lin.

Palpi maxill. art. 2° et 4° subcylindricis, 3° apicem versus sensim incrassato, sequente tertia parte longiore. Antennæ art. 7-8 subglobosis, 9° magno, ovato. Caput, thorax et elytra ut in præcedente sculpta et signata.

In lacu Colomb. mens. Jun. non infrequenter cepi.

This is in every respect a normal species. The prosternal

carina has a sharp edge; the claws are simple, the antennal club is composed of rounded joints, the elytra are of the typical structure, &c. In the latter respect, as well as with regard to the various series of punctures upon head, thorax, and elytra, it resembles the former; the punctures of the elytra are, however, less distinct. Joints 1-6 of the antennæ are yellowish, the club being dark and finely pubescent. The maxillary palpi have joints 2 and 4 subcylindric, but the intervening one thickened towards the tip.

I have frequently, in the month of June, taken the pupæ of this species on the banks of the Colombo Lake, and hatched them at home. I found them about 1 inch under ground, and often as far as 12 feet from the edge of the water, but still in muddy places. The imago is very active, perhaps more so than any other species of the genus.

[To be continued.]

XXX.—*Note on a Nematoid Worm, parasitic upon Termites.*

By C. LESPÉS*.

IN the course of my observations on the *Termites*, I have twice seen numerous nests, which appeared to be in a state of great prosperity, entirely destroyed in a few days. These two societies were established with me in large glass-vessels, but the earth of the nests was too moist; in this earth I then saw an immense number of little white worms swarming, and by examining them carefully and dissecting the *Termites* of these societies, I have been enabled to ascertain the history of the parasite. In its characters this Nematoid worm closely approaches *Leptodera* of Dujardin, but it must form a distinct generic group, as several of its characters differ from those of *Leptodera*:—its mouth is armed with three tubercles, its neck is short and thick, and lastly it is oviparous, whilst *Leptodera* is viviparous. The characters of the generative armature of the male are identical, but the aliform expansions so remarkable in M. Dujardin's worm are wanting in mine.

Genus ISAKIS.

Corpus fusiforme, extremitate caudali longe subulata haud alata. Caput corpore continuum, truncatum. Os trilabiatum. Penis vagina spiculisque duobus æqualibus instructus. Fœminæ apertura genitalis in corporis medio. *Ovipara*.

* Translated from the *Annales des Sciences Naturelles*, tome v. Zoologie, p. 335.

Isakis migrans (unih).

Corpus fusiforme, album : longit. maris 1·8 mill., feminae 2·5 mill.

Ovula elliptica : longit. 0·06 mill. ; lat. 0·04 mill.

Individua juniora, organis genitalibus nullis (e corpore *Termitum*) :
longit. fere 0·3, 0·4, usque ad 0·8 mill.

The adult males and females of this species are common in the earth of the two nests. They presented the remarkable property of being capable of being recalled to life after complete desiccation for more than a month. The males are rather less abundant than the females.

In these little creatures we may perfectly distinguish the digestive tube, which commences with a muscular pharynx, followed by an intestine which is straight in the male, and twisted into a spiral in the female. The former presents a slight tubercle a little above the tail ; in the corresponding part we see the two apicules of 0·05 mill. in length, and the sheath of 0·02 mill. which is placed below. The generative orifice of the female is placed about the middle of its length ; by transmitted light we see a great number of eggs filling the body.

With these animals I found an immense number of free eggs in different stages of development. Those furthest advanced contained an extremely mobile embryo. Some of these escaped, but there was still a gap between the young individuals and the adult or nearly adult forms. To supply this it is sufficient to dissect a Termite of the infested nest, when we find in the abdomen, around the intestine, but never in its interior, some Nematoid worms, very short and slender when compared with the adults ; they are in different stages of development, but the generative organs are always wanting. I found from one to six of them, but only in individuals of a certain size (workers, soldiers, nymphs). All my observations were made at the beginning of May, and in the second nest I verified them in June. The infested insects soon languish and at last die ; if they are then examined, the developed Nematoid worms are seen issuing from their bodies, which are becoming putrefied.

From these facts I think that all naturalists will admit with me, that the parasite of which I have just given the history, acquires its generative organs and propagates in moist earth ; that the young penetrate into the bodies of the *Termites*, become developed there, finally destroy their victim, and then escape to complete their growth.

The study of the probably numerous worms which have been united under the name of *Filarie* of Insects, was commenced by the remarkable work of Von Siebold upon *Mermis albicans*.

The facts which I have just described, seem to be a copy of those made known by that learned naturalist.

In the digestive tube of the *Termites*, I have found a considerable number of parasites.

XXXI.—*Brief Description of a Ctenostomatous Polyzoon, allied to Vesicularia, occurring on the Australian Coast.* By JOHN DENIS MACDONALD, Esq., Assistant Surgeon R.N.*

IN one of our visits to Moreton Bay, the sean was hauled at Moreton Island, and amongst the masses of sea-weed, &c. brought up with the net, I found numerous specimens of a very beautiful Polyzoon, a small portion of which I had previously dredged at Port Stevens from a depth of 5 or 6 fathoms.

The polypidom may be said to have consisted mainly of rooted, spreading and plant-like portions, and short, straight creeping trunks, connected at both extremities with the fixed part of the former, so that the whole presented the appearance of an open lace-work, having all the transparency and lustre of glass.

The trunks and branches were nearly perfectly cylindrical, and composed of an outer membranous sheath distended with a clear fluid (which escaped with considerable force when the sheath was ruptured), and line-like reticulated vessels disposed in one plane, so as to communicate laterally with the polyp-cells, and divide the axis longitudinally into equal halves. The more central canals of this vascular plane combined to form a compound vessel, which opened into a spherical sinus with cellular parietes at the base of each branch.

The ramification of the polypidom generally exhibited a trichotomous arrangement, with simple articulations occurring only where the branches were given off.

The cells were clustered in linear series on opposite sides of the branched axis, oval in shape, corneous in texture, with a terminal combed aperture, folding inwards by the contraction of four equidistant sets of muscular fibres, which imparted a quadrilateral figure to the opening.

The polypes were very minute, but exhibited distinctly all the important points of structure observable in those of *Vesicularia* and *Bowerbankia*, between which genera this polyzoon would appear to lie. The ciliated tentacula, like those of *Vesicularia*, are eight in number, and do not possess the motionless hair-like processes which project from the back of each in *Bowerbankia*.

Although too much importance must not be attached to the actual number of tentacula surrounding the oral aperture, the tendency to multiply those organs must not be altogether forgotten. Thus, while there are but eight in *Vesicularia*, *Bowerbankia densa* and *Bowerbankia repens* possess respectively ten and twelve.

* From the Proceedings of the Royal Society, February 19, 1857.

Both *Bowerbankia* and *Vesicularia* agree in the uniserial and unilateral distribution of the polypes, but in the present instance the cells are arranged in linear and bilateral clusters.

XXXII.—*Anatomical Description of a Species of Asteroid Polypes, probably forming the type of a new genus of Alcyonidæ.*

By JOHN DENIS MACDONALD, Assistant Surgeon R.N.*

ON leaving the Conway Reef (lat. $21^{\circ} 44' 48''$ S., long. $174^{\circ} 37' 45''$ E.), July 4, 1855, a very beautiful branched asteroid Zoophyte, belonging to the Alcyonidæ, was brought up from a depth of between 30 and 40 fathoms, on the buoy-rope of the anchor.

The polypidom, from a trunk of about one inch and a half in diameter, branched off, with much irregularity, but generally in a dichotomous manner, into very minute subdivisions.

The investing membrane was strengthened by the close deposition of elongated, fusiform, and minutely tuberculated spicula of a deep crimson-lake tint, which impart their colour to the whole mass.

The internal substance was chiefly composed of longitudinal muscular septa, radiating from the central axis (which contained no denser material), frequently communicating with one another laterally, and being fixed into the internal surface of the integument in vertical lines. These muscular septa were invested on each side with a layer of finely reticulated vessels, both sets being connected by numerous transverse trunks passing through the intervening muscular tissue, and the spaces between the septa were filled with a transparent glairy fluid.

The polyp-cells were exposed and solitary, resting on the internal surface of short branchlets strengthened by large dorsal spicula, one of which, much larger than the rest, extended considerably beyond the polyp-cells, tapering gently to a needle-like point. These latter spicula are covered with tubercles, and in every respect but in size similar to those of the general integument.

The small spicula on the internal or ventral surface of the branchlets diverge from one another in the peripheral direction, while those on the dorsal border are disposed longitudinally.

The mouth of each cup-like polyp-cell was surrounded with about eight projecting spicula, whose fixed extremities were curved upwards and inwards, festoon-fashion, while numerous smaller ones were so disposed as to fill up the open spaces posteriorly, and thus strengthen the body of the cell.

Although I have not been able to count the number of the oral tentacula satisfactorily, from their proportional size I can readily believe that there were about eight in this species, as in most if not all other asteroid polypes. They were broad and flat, tapering to a blunt point, like those of *Sarcodictyon* (Forbes), to which genus I have no doubt this Zoophyte is nearly allied, though the habit of the polypidom is so very different.

* From the Proceedings of the Royal Society, March 12, 1857.

BIBLIOGRAPHICAL NOTICES.

Dr. Jacob Sturm's Deutschlands Flora in Abbildungen nach der Natur mit Beschreibungen. Fortgesetzt von Dr. J. W. STURM. 95 and 96 Heft. Small 12mo. Nurnberg, 1855.

WE have recently received a new fasciculus, containing two numbers (95 and 96) of this excellent collection of plates of the Flowering Plants of Germany, and are sorry to observe the long intervals that elapse between the issues of it. Nos. 91 and 92 are dated in 1846; Nos. 93 and 94 in 1849; and those recently received, in 1855. It is much to be feared that the work does not now receive the support that it deserves.

The plates in these numbers fully support the character formerly acquired by the work. They are amongst the most beautiful and accurate representations which we possess of plants indigenous to Northern Europe. The last four numbers are edited by Dr. J. W. Sturm, who undertook the continuation of it on the death of the celebrated Koch, by whom it had been conducted for some years.

The following is a list of the contents of Nos. 95 and 96 :—

Ranunculus pygmaeus, Wuhl.
— *montanus*, var. *minutus*, Leybold.
Rhamnus Frangula, L.
Herniaria glabra, L.
Convallaria multiflora, L.
Ornithogalum umbellatum, L.
— *nutans*, L.
Acer campestre, L.
Adoxa Moschatellina, L.
Scleranthus perennis, L.
— *annuus*, L.

Rubus saxatilis, L.
Daphne petraea, Leybold.
Tilia grandifolia, Ehrh.
— *parvifolia*, Ehrh.
Carex ornithopodioides, Hausm.
Helianthemum vulgare, Gaert.
Nymphæa semiaperta, Klinggräff.
— *alba*, L.
Corydalis foliacea, Pers.
Lathyrus hirsutus, L.
Pinus sylvestris, L.
Quercus pedunculata, Ehrh.

Of these, *Daphne petraea* and *Carex ornithopodioides* are new species, published in the Journal called 'Flora,' in 1853, and never before figured. They are both described here by Leybold. The former is allied to *D. Cneorum* and the latter to *C. ornithopoda*. The *Nymphæa semiaperta* was first published by Klinggräff in the 'Flora von Preussen,' in 1848, and is identical with the *N. neglecta* of Hausleutner in Mohl's Bot. Zeit. for 1850. It differs from *N. alba* in several respects, especially in the column upon which the styles are elevated, and the flattened and furrowed inner side of these organs. In so variable a tribe of plants, its claims to specific distinction may admit of doubt. It is fully illustrated on two plates.

The plates of the *Scleranthi* beautifully show the distinctions between two plants which have often been unadvisedly confounded, especially in England.

We may be allowed to express a hope that Dr. Sturm will receive the support that he so well deserves, and may be encouraged to continue the work more rapidly in future.

Iconographia Familiarum Naturalium Regni Vegetabilis delineata atque adjectis Familiarum characteribus, &c. ornata. Auctore A. SCHNIZLEIN, Dr. Ph. 4to. Bonn.

After a long interval, another number (xi.) of this valuable series of illustrations of the Natural Orders of Plants has been recently received. It contains elaborate figures, with very many anatomical details of the Orders noticed in it, and is quite equal in excellence to the former parts of this beautiful work. As has been remarked in speaking of Sturm's 'Flora,' it is to be feared that here also want of support is the cause of delay in publication. Few works have been slower in their publication, it being now fully fourteen years since the first number appeared, and there is still much wanted to render it complete. We much desire to see its continuation, as we have found it of great use in our botanical studies.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

February '12, 1857.—W. R. Grove, Esq., V.P., in the Chair.

"Researches on the Reproductive Organs of the Annelids." By Thomas Williams, M.D., F.L.S.

In this paper the author seeks to establish the following general proposition, viz. that there prevails throughout the Actiniadæ, Echinodermata, Rotifera and Annelida, a special organ, which, under different phases, subserves different functions, which is essentially *identifiable* under every modification, reducible to the same type, and which constitutes the *root* of the Reproductive system in these families. To this special organ he proposes to apply the provisional name of the "*segmental organ**." In the chambers which are enclosed by the vertical dissepiments dividing the body of *Actinia*, convoluted tubular cords are contained which support the generative structures. It has not yet been proved whether the internal ends of these tubules open directly into the perivisceral chamber. These cords and their appended structures in the Actiniadæ constitute the *type* of a system of organs the prevalence of which throughout the Echinodermata, Rotifera and Annelida can, he believes, be clearly and satisfactorily proved. In the present memoir, however, the author proposes to confine his demonstrations to the anatomical varieties which the segmental organ presents in the class *Annelida*, contenting himself with merely in a passing manner pointing out the fact that the several variations of form, structure and number which this organ exhibits in the several genera of this class, are *represented* by similar variations in the different genera, especially of the class Echinodermata. He hoped to show that under very numerous appa-

* While he is convinced that the identity of this organ might readily be traced throughout other families of the lower Invertebrata, he will not permit himself at present to indulge in any wider generalization than that stated in the text.

rent varieties, the essential unity of the segmental organ within the indicated limits can be convincingly established.

Upon this organ, under different circumstances, there devolve one or two or even more functions. Sometimes it is used as a simple *discharge tube*, conveying externally in a direct manner the fluid of the general cavity of the body. This variety is exemplified in the segmental organs which are distributed, in the genera *Lumbricus* and *Nais*, throughout all that part of the body which is situated posterior to the Reproductive band. In this latter region two or more of these organs are so modified as to become the basis whereon are developed the generative structures.

Here the author enters upon a minute account (illustrated by figures) of the history of this organ in *Lumbricus* and *Nais*, showing the changes of outward form which it undergoes in several species of these genera.

He points out in this place that the segmental organ, as it occurs in *Lumbricus* and *Nais*, is paralleled by the so-called water-vascular system of the Rotifera: as in the former so in the latter, the ciliated tubes communicate freely with the general cavity; in both, the current raised by the cilia travels from within outwards; and he contends that the reproductive structures are ingrafted upon, or developed from one, two or more of the ciliated tubes in the Rotifera, as from the segmental organs of *Lumbricus* and *Nais*.

Arenicola and *Terebella* form a group in which the segmental organ deviates in a remarkable apparent manner from that of *Lumbricus* and *Nais*. It forms a series of elongated sacculi, which are attached to the ventral wall of the general cavity on either side of the median line. Each sacculus, although single at its distal end, is divided at its attached end into two tubular limbs, one of which communicates directly with the exterior, while the other opens immediately into the general cavity of the body. Through the latter limb the *ova* and *sperm-cells* are introduced into the perivisceral chamber, while in the reverse direction the *fluid* of this chamber is discharged externally. The author has never been able to discover how the germ- and sperm-cells (respectively in the female and male) escape out of the general cavity; but he trusts that he has given a new and satisfactory demonstration of the mode in which they enter that cavity. The genera *Arenicola* and *Terebella* comprehend the *only Annelids* in which the germ-elements in the female, and the sperm-cells in the male, are ushered into, and are required to sojourn for a season in the fluid of the general cavity of the body.

He indicates in this place that the segmental organ of the Sipunculidæ (amongst the Echinoderms) corresponds both in its structure and relations to that of *Arenicola* and *Terebella*, with this difference only, that in the latter a special and *peculiar development* of the blood-vascular system occurs around and in the vicinity of the segmental organ, whereas in the Sipunculidæ this system scarcely exists and never receives any enlargement. The segmental organs in the genus *Synapta* stand in an intermediate position between those of *Holothuria* and those of *Sipunculus*. In *Synapta* one or more

organs remain in the condition of simple 'discharge tubes,' while others become developed into the Reproductive structures.

The segmental organs of the Hirudinaceæ are next described. The author adheres almost in every detail to the results published by him in 1851 in the Reports of the British Association, with reference to the reproductive system of this family of *Annelids*. In the present memoir he records the results of new and carefully conducted dissections, which prove that in the Common Leech, the Sea-leech, and probably in the genus *Clepsina*, there is situated an organ on either side of the ventral median line, which is repeated in *every ring of the body*, and which in this family is the true ovigerous apparatus, the testes constituting a separate and more medianly disposed series of glandular bodies, whose homologies he has not yet satisfactorily determined.

The so-called "respiratory sacculus" of Dugès he now looks upon as the process of the ovario-segmental organ, by which a communication is established between the latter and the general cavity of the body, and by which the fluid of this chamber escapes externally. All the Hirudinaceæ are androgynous.

Under the Nereid group is included in this memoir, the genera *Nereis*, *Aricia*, *Phyllodoce*, *Nephtys*, *Syllis* and *Nerine*. The segmental organ in these families is specially described and figured. In all, the sexes are seated on separate individuals. In no single instance is the general cavity rendered subservient to the incubatory process. In all, the general circumference of the organ is lobulated and irregular, entering the hollow bases of the cirrhi and blended most intimately with the blood-vascular system.

Glycera and *Cirrhatus* the author classes together, on account partly of the similarity of form and structure of the segmental organ, but especially because in both the *blood-vascular system is completely and entirely wanting*, its absence being compensated by the existence of a second order of pigment-carrying corpuscles in the cavitary fluid. These genera are unisexual, and at no time are the germ- and sperm-elements introduced into the perivisceral chamber.

In this and the preceding groups the author has not succeeded in discovering the mode in which the segmental organ opens into the general cavity; but from the fact that it has a looped arrangement, supported on two tubular limbs, he is quite convinced that an opening into this cavity, for the purpose of giving direct outlet to its contents, does really exist. This conclusion is fortified by the analogy of the form under which the organ exists, in the Nereid group in general.

The *Nemertine Annelids* are then examined. The author recalls the results of his researches as published in his 'Report' on the Annelids in 1851. His renewed investigations have confirmed the statements which he then put forth. He still contends that what M. Quatrefages has described in these worms as the *ovary* is a great alimentary cæcum, and that the Reproductive system consists in a double series of segmental organs, one on either side of this great cæcum and the ventral median line; that in this family the sexes are

seated on separate individuals; that the reproductive elements at no time find their way into the general cavity; that in fact these Annelids, anomalous only in the disposition of their alimentary system, conform, as regards the type and mode of repetition of segmental organs, to the standard offered by the great Nereid group.

Chloræma Dujardinii, especially the female, presents an extremely favourable opportunity of observing the *looped arrangement* of the segmental organ, and of proving the fact, so constantly seen in the other families of Annelids, viz. that *one limb* of the loop is the true ovary, or the primary seat of the ovo-genesis; that the ovules travel round the curve of the loop; that they acquire a considerably developed size at the other limb, just before they escape externally. In *Chloræma* the vitelline body of the ova is almost ink-black. The entire extent of the segmental organ is thus rendered perfectly and easily traceable amid the surrounding transparent structures. In this genus it does not at present appear that either limb of the loop opens into the general cavity. This type prevails, as far as he knows at present, throughout the Nereid group; in other words, in these Annelids the function of a *discharge tube* does not appear to be thrown upon the segmental organ under any circumstances; hence the limited dimensions of the general cavity and the highly developed character of the blood-vascular apparatus.

The group lastly examined is that of the Aphroditaceæ. On the reproductive organs of this large, numerous and interesting family, no single observation is contained in any work on comparative anatomy that the author is acquainted with. He enters upon a detailed account of his own researches. They have ended in what he would fain believe to be a complete solution of the difficulties in which the history of the Reproductive or segmental system of this family has been hitherto shrouded. This family, without exception, is unisexual. The segmental organs constitute a complete and regularly branched series, situated, as in all other Annelids, on either side of the ventral median line. They embrace, like a gauze-work, the diverticula of the alimentary system, with which they correspond in number. They fall under the general designation of the "segmental organ," in the feature of their having *two limbs*, being therefore looped, although only rudimentarily. The author then proceeds to give an account of his studies into the history of this organ amongst the grotesque and highly varied species of the genus *Polynoe*. They have rendered it certain that throughout the family of the Aphroditaceæ there obtains but *one type of segmental organ*, and that upon it always are ingrafted the generative structures.

At this stage the attempt is made to show that the segmental organs of the Echinidæ, Asteriadæ and Holothuriadæ conform, structurally and functionally, in the most remarkably intimate manner with the typical standard exhibited by this organ in the Aphroditaceæ. But between these Echinoderm and Annelidan families the author attempts to indicate other zoological affinities. He shows, that, according to his researches amongst the Aphroditaceæ, there is no trace whatever to be discovered of a blood-vascular system. In

this respect they correspond with the Echinidan and Asteridan families. He shows that in the Aphroditaceæ the general cavity is never, under any circumstances, used as an incubatory chamber. In this point of their generative history the Echinidæ and Asteriadæ exactly agree with the Aphroditaceæ.

The author regrets, that, in consequence of the difficulty of obtaining specimens, he is obliged to defer to a second memoir many special points of anatomical structure and physiological relations, the determination of which he still feels to be necessary to the complete history of the segmental organ in the Annulose and Radiated classes.

February 19, 1857.—Dr. W. A. Miller, V.P., in the Chair.

“Further Observations on the Anatomy and Physiology of *Nautilus*.” By John D. Macdonald, Esq., Assistant Surgeon R.N.

Both Professors Owen and Valenciennes noticed that the hollow subocular process of their specimens of *Nautilus Pompilius* was not tentaculiferous, and I may be permitted to say that this was also true of several examples of *Nautilus Pompilius*, and one of *N. macromphalus*, examined by me. But there is still another matter worthy of remark with reference to this process, namely, that its cavity may be traced downwards, inwards, and a little forwards, to within about the twentieth of an inch of the auditory capsule; indeed it would appear as though provision had been made for the entrance of sonorous waves through a rudimentary external ear.

There can be little doubt that the eye itself is a modified tentacular sheath, so fashioned and endowed as to become the seat of the special sense of vision; but the subserviency of such a part to the faculty of hearing is much more obviously seen in the subocular process just noticed, which holds an intermediate position between the organ of vision and the tentaculiferous sheaths protecting the proper organs of touch.

In a figure which accompanied this communication, the auditory sac is exposed by an incision made in the groove between the funnel-lobe and the base of the tentacular sheaths. The subocular process is slit open to the bottom of its cavity, so as to show its termination in close proximity to the ear-sac. The interior of the tube is lined with a glandular membrane thrown into small folds, disposed longitudinally, but the exterior of the process is quite smooth like the rest of the integument.

I have often had some little difficulty in detecting the otoliths or otoconia, as the case may have been, in gasteropods long immersed in spirits or other preservative fluids; but in a specimen of *N. Pompilius*, kept for many months in strong gin, although the soft parts were far from being well preserved, I was enabled at the first attempt to remove the contents of the auditory sacs, and the minute elliptical otoconial particles, identical in character with those of *N. macromphalus*, were very distinctly seen under the microscope.

In a former paper, I first noticed my discovery of simple auditory capsules in, as I then supposed, the *N. umbilicatus*; but I find that

I have incorrectly named my specimen, for on comparing the shell with the drawings of the several existing *Nautili* given in Sowerby's 'Thesaurus Conchyliorum,' it agreed exactly with the figure of *N. macromphalus*. I am indebted to my friend Mr. S. Stutchbury for the perusal of the work referred to, and my error is sufficiently accounted for by the scantiness of my own library.

With reference to the action of the great lateral muscles of *Nautilus*, the following ideas have suggested themselves to my mind.

As though preparatory to the complete separation of the body of the Cephalopod from the shell, which usually occurs in the lower genera, the fasciculi composing the lateral muscles in *Nautilus* do not perforate the mantle, and therefore cannot be directly fixed into the shell; they are, however, connected with it through the medium of thin filmy layers of a corneous texture, which frequently remain attached to the shell after the animal has been removed. The feeble hold of those muscles, even in a very recent state, is thus readily accounted for. Indeed, it is highly probable that the fixity of the body of *Nautilus* during the inhalation and forcible ejection of the respiratory currents is effected by the shell-muscles reacting upon one another, on the principle of a spring purchase, rather than by simple traction, as illustrated by the withdrawal of a gasteropod within its retreat, or the closure of the valves of a conchifer by the adductor muscles.

This view, which is supported by the foregoing facts, has its principal basis in the line of direction of the shell-muscles, and the angle at which they meet one another, at the root of the funnel-lobe; for the outer extremity of each being fixed, it follows that the first effect of the contraction of the muscular fibres would be to increase the angle just noticed; and this cannot possibly be accomplished, according to the recognized laws of muscular action, without tending to throw apart the points of origin, or in other words, exerting outward pressure against the internal wall of the shell, and thus, as it were, jamming the occupant tightly in its cell.

The action of the great lateral muscles of *Nautilus* here supposed, affords a remarkable contrast with the mode in which the posterior expanded arms of *Argonauta* embrace the exterior of its shell, particularly during the ejection of the expiratory current; while the withdrawal of the gasteropod into its abode, by the contraction of a veritable retractor, exhibits the exertion of muscular force in a very different direction.

In regard to the supposition that *Nautilus macromphalus* is the male of *N. Pompilius*, I may remark, that, besides my own specimen of the former, which proved to be a female, another, in very excellent condition, lately deposited in the Sydney Museum, is of the same sex.

February 26, 1857.—The Lord Wrottesley, President, in the Chair.

"Observations on the Natural Affinities and Classification of Gasteropoda." By John Denis Macdonald, Assistant Surgeon R.N.

During his sojourn among the Feejee Islands, the author devoted

much time to the anatomical investigation of recent Gasteropoda, with the view of discovering such indications of affinity in the details of structure as might serve as a basis for a natural arrangement of the Order; and the present paper is designed to give a statement of some of the results of his researches, in order that the affinities of structure developed may be fairly examined and taken for what they are worth as principles of classification.

After pointing out objections to the foundation of primary divisions among the Gasteropoda on characters derived from the shell or from modifications of the respiratory organs, the author observes in respect of the value of sexual characters, that when the distinguishing features of a class are once satisfactorily determined, and this contains forms in which the sexes are either separate, or combined in the individuals, no other characters can be of greater importance in establishing primary divisions. As a means of further subdivision according to natural affinities, he suggests distinctive characters derivable from the auditory sacs and concretions, and from the oral, lingual and gastric dental organs.

In Mollusca, as in Fishes, the auditory concretions present themselves in one of two forms, viz. solitary lapilli, usually named *otolithes*, or groups of small granules of a rounded oval or irregular shape, which have been designated by the term *otoconia*. The lingual teeth are either set together on a short and broad lingual membrane, and form what the author calls a *lingual pavement*, or on a narrow longitudinal band termed *lingual ribbon* or *strap*. The latter usually consists of a median *rachis* flanked by two lateral portions or *pleuræ*; but in some cases the *rachis*, and in others the *pleuræ* are absent, and the number of longitudinal rows of teeth in these divisions may also differ in different genera. The fore part of the lingual membrane is supported by cartilage, so curved and fashioned as to receive the lingual sac behind, and form a basis to the tongue itself projecting in front. This lingual cartilage may consist of a single piece thinned in the middle line, or of two or four distinct pieces, similarly arranged and wrapped together by muscle and ligament. The oral dental organs or *labial plates* are disposed either horizontally or laterally. In the former case a single plate may occupy the upper lip, or there may be two guarding the aperture of the mouth, and corresponding with both upper and lower lip, but the lateral plates are always in pairs. Gastric teeth occur in the Aplysiadæ and Bullidæ.

After pointing out further differences in the form and arrangement of the dental apparatus in different genera, the author thus describes the mode of development of the lingual teeth:—"The lingual sac at first appears as a little caecal process appended to the inferior part of the œsophagus, where it joins the oral cavity. In the median line of the floor of this sacculus, a few minute plates disposed in a longitudinal row form the rudiment of the future *rachis*, and the progress of their development may be distinctly traced on examining them, *seriatim*, from before backwards, in which direction, as their growth advances, they acquire a more perfect form. The internal row of pleural plates now makes its appearance, their development proceeding in a

similar way ; and after this follow the others according to their position, the more internal arising first. Thus the whole ribbon of dental organs increases in length and breadth by additions made respectively to its anterior extremity and sides ; and each transverse row gradually moving backwards by the continued development and growth of others anterior to it, causes elongation of the lingual sac, which only attains its perfect state when these processes are at an end. The idea, therefore, that the new teeth are developed from behind forwards and successively brought into use, as in sharks and rays among fishes, does not appear to me to be correct."

In the annexed Table a rough arrangement is given of a considerable number of genera grouped together by the characters above referred to. Although the author thinks it improbable that any genera opposed to each other in those fundamental particulars can be intimately related, yet the facts are not advanced as the basis of a new classification, but simply that they may yield their own weight, as so many available tests of affinity.

Sexes separate.				Sexes combined.			
Otolithes		Otoconia		Otoconia		Otolithes.	
Strap.	Pavement.	Pavement.	Strap.	Strap.	Pavement.	Pavement	Strap.
Oxygyrus	Triphoris	Solarium.	Helleina	Patella	Imax.	Ianthina.	Vermetus.
Atlanta.	—	—	Navicella	Dentalium.	Palmacella.	—	Serpuloides.
Carnaria.	—	—	Neritina.	—	Heli.	—	Filicopsis.
Cardipoda	—	—	Nerita	—	Helicella.	—	Hyponyx.
Fiola.	—	—	Trochus.	—	Carocella.	—	Pedicularia.
Cerophora.	—	—	Delphinula.	—	Bulmus.	—	Glaucus.
Eges.	—	—	Turbo.	—	Partula.	—	Eolidia.
Synca.	—	—	Stomatella.	—	Vertigo.	—	&c.
Melania.	—	—	Broderipia.	—	Physa.	—	—
Truncatella.	—	—	Haliotis.	—	Planorbis.	—	—
Planaxis.	—	—	&c.	—	Senarbus.	—	—
Litopa.	—	—	Cyclophorus.	—	Conovulus.	—	—
Litorina.	—	—	Diplommatina.	—	Siphonaria.	—	—
Lacuna.	—	—	Papina.	—	Amphibola.	—	—
Natica.	—	—	—	—	Tornatella.	—	—
Triton.	—	—	—	—	Dolebella.	—	—
Ranella.	—	—	—	—	Bulla.	—	—
Terebellum.	—	—	—	—	Cylindrus.	—	—
Strombus.	—	—	—	—	Doris.	—	—
Mitra.	—	—	—	—	Pleurobranchus.	—	—
Harpa.	—	—	—	—	Phylliroe.	—	—
Oliv.	—	—	—	—	—	—	—
Ricinus.	—	—	—	—	—	—	—
Purpura.	—	—	—	—	—	—	—
Murex.	—	—	—	—	—	—	—
Muricea.	—	—	—	—	—	—	—
Cyrtulus.	—	—	—	—	—	—	—
Tritonides.	—	—	—	—	—	—	—
Buccinum.	—	—	—	—	—	—	—
Nassa.	—	—	—	—	—	—	—
Fusotoma.	—	—	—	—	—	—	—
Columbella.	—	—	—	—	—	—	—
Comida.	—	—	—	—	—	—	—
Pleurotoma.	—	—	—	—	—	—	—
Terebra.	—	—	—	—	—	—	—
Canorbis.	—	—	—	—	—	—	—
Genus.	—	—	—	—	—	—	—

Murex, *Triton*, and *Ranella* have always been associated together as members of one family by universal consent, and it must be confessed that the external resemblance between them is very remarkable; but on comparing the lingual and labial dental organs of *Triton* or *Ranella* with those of *Murex*, it will be at once perceived that the latter genus can have no immediate affinity with either of the former genera.

The aperture of the proboscis in *Murex* is transverse, and armed with two horizontally arranged dental plates, connected laterally by the minute semi-calcified cells which line this part. The upper plate presents a rough palatal surface, with an anterior encrusted cutting border, much resembling that of the crescentic mandible of *Limax* or *Helix*; whereas the dental plates of *Triton* and *Ranella* consist of oblique rhombic cells identical in character with those of *Cyclophorus* or *Natica*, disposed laterally. Again, on comparing the lingual strap of *Murex* with that of *Triton* or *Ranella*, we remark, first, that each transverse row of the former consists of three members, viz. one in the rachis, and one in each pleura, while in the two latter cases the pleuræ present two additional elements; thus there are seven series of dental plates in the strap. The tongue-strap of *Murex*, moreover, is elongated like that of *Purpura* and *Ricinula*, both of which genera are more closely allied to *Murex* than perhaps any others referred to its family.

The strap of *Triton* and *Ranella*, on the other hand, is comparatively much shorter, and singularly enough more nearly approaches that of *Pileopsis* or *Vermetus*, not only in general proportions, but also in the actual number and configuration of the dental plates and processes. Now with these facts before us, it will be scarcely worth while entering further into the characters of the lingual dentition of *Murex*, *Triton*, and *Ranella*, but the most superficial examination will show that *Murex* must be separated from its assumed alliance with *Triton* and *Ranella*, while the close relationship of the two latter genera gains additional support.

On comparing the lingual dentition of the genus *Cyrtulus* with that of *Tritonidea* of Swainson (the *Polia* of Gray), both are found to be naturally allied by characters which very distinctly manifest a family relationship, and Swainson's genus *Muricidea*, with several others, must also be referred to this group. The elongated triserial ribbon of *Cyrtulus*, or *Tritonidea*, for example, exhibits no true or immediate affinity with the comparatively short and septiserial dental armature of *Triton* or *Ranella*. Thus the author is induced to dissent from Dr. Gray's view that *Tritonidea* is allied to *Triton*, but agrees with him that the *Buccinidæ*, forming an equally characteristic natural family, are very close at hand.

The lingual dentition, and in fact the whole anatomy of *Terebra*, most unequivocally refers it to the *Conidæ*, and not to the *Buccinidæ*, amongst which it is at present received.

The author has not been able to detect lingual cartilages of the usual character in *Conus*, *Conorbis*, or *Terebra*, but the walls of the tongue-sac are stout, tough, and distinctly cartilaginous in structure;

indeed the whole organ, including its armature, very much resembles the dental cheek-pouches of some Pteropods.

The lingual ribbon of *Pleurotoma* is exceedingly minute, and the parietes of the sac are not of that dense and unyielding character which they exhibit in *Conus*, *Conorbis**, and *Terebra*. Moreover, in *Pleurotoma* the little lingual membrane is supported by two rounded masses of cartilage composed of large spheroidal cells. The rachis appears to be absent altogether, and there is but a single row of elongated, slightly curved, and sharp-pointed teeth (differing considerably from those of *Conus* and *Terebra*) in the pleuræ.

The tongue-strap of *Mitra*, although remarkably short, is triserial like that of *Murex*, *Purpura*, &c.; but the author has invariably found that in those *Mitræ* in which the sculpturing of the shell was transverse, the pleural teeth were simple, uncinatæ, and mobile, while in those species characterized by a smooth surface or longitudinal sculpturing, the dental processes were small, straight, and numerous, arising just within the posterior border of broad basal plates. This difference is exactly such as exists between the lingual dentition of the respective groups to which *Murex* and *Tritonidea* belong.

Harpa and *Oliva* are very closely allied, by the general configuration of the body and the characters of the lingual dentition, though it must be remembered that the tongue-strap in the former is so very minute, compared with the whole bulk of the animal, as to appear quite rudimentary. The simple lateral uncini, moreover, are only distinctly visible towards the posterior extremity of the sac. Both these genera seem to be more intimately related to *Murex* and its congeners than to the *Buccinidæ*.

Triphoris is now, as it would appear from the characters of its shell alone, placed with *Cerithium*, but the comparison of the internal anatomy of those genera offers no countenance to their supposed affinity; thus, single spherical otolithes occupy the auditory sacs of *Triphoris*, while those of *Cerithium* contain otoconia. The proboscis of the former is long and retractile. The lingual membrane of *Triphoris* besides, though long and ribbon-like, supports a multiserial pavement of minute teeth, while that of *Cerithium* is septiserial, resembling in many particulars the tongue-strap of *Pupina* and allied forms.

The *Columbellæ* deserve to be elevated to the rank of a family, distinguished from the *Buccinidæ* by the unarmed rachis, and curved versatile pleural teeth of the tongue-strap.

Although not fully satisfied of the propriety of separating the genus *Conidea* from *Columbella*, the author thinks there can be no doubt that *Pusioatoma*, formerly placed with the *Columbellæ*, forms a very distinct genus clearly referable to the *Buccinidæ*.

As great difference of opinion has always existed as to the distribution of the sexes amongst Gasteropods, so far the author is unable to vouch for the whole truth of the arrangement above given, but he thinks that if there is anything incongruous in it, the correction of

* Several specimens of a recent species of this genus (hitherto known only in a fossil state) were obtained from depths ranging between 10 and 20 fathoms, within the barrier reefs surrounding the Feejee Islands.

errors in that particular would seem to be most likely to restore harmony and support the truth of the system.

In the course of his inquiries the author was impressed with the fact, that various genera of terrestrial Gasteropods, which agree with each other as far as regards their respiratory organs and mode of respiration, differ essentially in their general organization, whereas they are in this respect severally related to fluviatile and marine genera, which are obviously constructed on the same anatomical type.

In this way a terrestrial genus, having few structural points of agreement to connect it laterally, as it were, with others of the same habit, forms a member of a beautifully connected natural series, traceable from it through fluviatile and littoral forms to others which are altogether marine.

As an example of these relations the following Table is given, and it might have been extended and rendered more complete, had the author not preferred to limit it to such cases as have come under his own examination.

	Sexes combined.		Sexes separate.	
	Otoconia.		Otoconia.	Otolithes.
	Pavement.		Lingual ribbon.	Ribbon.
	Teeth numerous, uniform in character.	Rachis and Pleuræ multiserial.	Rachis uniserial, Pleuræ triserial.	Rachis uniserial, Pleuræ triserial.
Terrestrial...	Helix. Bulimus.	Helicina. —	Cyclophorus. Diplommatina. Pupina. ?	Egea. — — —
Fluviatile...	Physa. Planorbis.	Navicella. Neritina.	— — —	Melania. — —
Leading to purely marine genera.	Scarabus. Conovulus. Siphonaria. Amphibola.	Nerita. Turbo. Stomatella. Broderipia.	Cerithium. — — —	Hydrobia. Planaxis. Litiopa. —

This Table shows the natural affinities of four principal divisions of terrestrial Gasteropods, proceeding, as it were, in parallel lines, without any very obvious lateral connexions, through fluviatile and littoral forms, conducting to certain marine genera distinguished by this alliance from all others having no terrestrial representatives, and being therefore more restrictedly marine. It may be remarked that the importance of the characters placed at the head of the Table has been proved by the comparison of other anatomical particulars in those genera, and so far their efficiency in other cases is substantiated.

The author adds the following observations on the anatomy of the *Siphonaria* and *Amphibola*, as bearing on their position in the first series of the foregoing Table :—

"*Siphonaria* appears to enjoy the power of breathing in both air and water with equal facility, and on examination, we find the respiratory surface so constituted as to afford a ready explanation of the fact. Thus, in connexion with a narrow, combed, or rather transversely plaited gill, numerous vessels ramify extensively, and anastomose freely upon the roof of the respiratory chamber. The mouth is armed with lateral labial plates, and the lingual dentition is not unlike that of *Amphibola*, to which genus it is further related by the absence of tentacula, and the general configuration of its head.

"*Amphibola* exhibits a close relationship to the Pulmonifera in many essential anatomical points, but it has a veritable combed gill, which, arising from a deep recess on the left side of the branchial chamber, and thence passing obliquely forwards towards the right side, terminates in a pointed extremity, in front of which there is a small glandular body, probably a renal organ. The margin of the mantle may be traced continuously round the neck and the base of the foot, being attached in its entire extent, with the exception of a small portion which arches over a narrow respiratory opening on the right side of the nape. The lingual sac is small, like a cæcal process appended to the antero-inferior part of the œsophagus. The dental organs present a pavement of narrow basal plates with very long and gently curved cusps. The teeth of the central series are much larger than the rest, and exhibit a remarkable conformation; thus a rounded process projects in the middle and several minute denticulations arm its base on either side. I have not succeeded in detecting either lingual cartilages or labial plates in my spirit-preserved specimens, and but for the support furnished by analogy, I would incline to the belief that they are absent in the present case.

"The remark made by Mr. Woodward in his very valuable little work the 'Manual of Mollusca,' that the anomalous genus *Amphibola* has an unusually broad tongue armed with teeth similar to those of the Snail, is not quite correct. The misconception most probably originated in the inspection of a preparation belonging to Mr. Wilton of Gloucester, and from which Mr. Woodward's figure has been taken, as 'part of the tongue of *Amphibola avellana*;' but having myself dissected several specimens of this very species obtained at New Zealand, I am satisfied that Mr. Wilton's preparation has been by some accident improperly named.

"The general scheme of the generative system in *Amphibola* corresponds very closely with that of *Helix*, *Bulimus*, and such Pulmonifera. The ovarium is imbedded in the liver near the summit of its spiral turns, and a small convoluted oviduct leads downwards and forwards along its inner or concave side. The testis lies considerably in advance of the ovary; the intromittent organ forms a prominence in the floor of the respiratory chamber, and finally the generative orifices open on the right side."

ZOOLOGICAL SOCIETY.

June 24, 1856.—Dr. Gray, F.R.S., in the Chair.

DESCRIPTION OF MYGALE EMILIA, A SPIDER FROM PANAMA, HITHERTO APPARENTLY UNRECORDED. BY ADAM WHITE, ASSISTANT IN THE ZOOLOGICAL DEPARTMENT, BRIT. MUS.

The large Spiders of the New World, though generally sombre in hue, are occasionally varied in colour. The *Mygale versicolor* described by Baron Walckenaer (Apt. i. 211), has the cephalothorax covered with down-like hairs of a metallic green lustre, and some of the hairs of the body have in certain aspects a violet reflection. The *Mygale rosea* described by the same author from the collection of M. Guérin-Méneville, who procured it from Chili, is deserving of its specific name. The *Mygale Zebra*, figured in the fourth volume of the 'Annales de la Soc. Entomologique,' pl. 19, has the abdomen strikingly striped. Generally speaking, however, these large *Mygales*, whether from the Old or the New World, are rough, plain brown, or black creatures, with greyish scattered hairs. Since Walckenaer's work was published in 1837, several species have been added to zoological science, especially in the German work of Koch. The following species, pre-eminent for its striking beauty of colour, was obtained by my friend Dr. Berthold Seemann, the distinguished naturalist who succeeded Mr. Edmonstone on board H.M.S. Herald under Capt. Kellett, R.N., C.B.

I have but once seen a *Mygale* alive; the specimen was sent to the late Mr. John Doubleday by post, and when it reached London was evidently much shaken by its transit from Liverpool. The day after its arrival he gave it cockroaches. They were put into the small box along with the *Mygale*. It apparently at first did not see them, but on these "Cursorial Orthoptera" running about *Mygale's* legs, the great spider drew itself up, and darted its chelicera into one of them, tearing its intestines with its fearfully armed hook. The *Blatta* was soon devoured, and the spider, evidently an invalid after its rough journey, died next day.

Mr. H. W. Bates, who has for the last eight years so successfully collected Annulosa, and observed their habits at various points on the Amazon, in a letter to me, dated "Santarom, 30 April, 1855," written on the eve of starting for "the wonderful country of the Upper Amazons," remarks:—"With regard to spiders, I have observed many curious points in their habits, but I cannot communicate them until I can send specimens, with numbers attached, to which the notes can be referred. There is one observation I made, however, which I am sure will be of the highest interest to science. It is with respect to the habit of the *Mygales* to prey on birds. Now I have detected them in the fact as far back as 1849, but thought little of it at the time, as I had the idea that it was a well-known and undisputed fact in science. Lately, however, I read an account (I think of Langsdorff's expedition in the interior of Brazil), where

the fact is considered to rest on no foundation, and to be one *more* of the fables originated by Madame Merian. Now I will relate to you what I saw. In the month of June 1849, in the neighbourhood of Cameta, I was attracted by a curious movement of the large grey-brown *Mygale* on the trunk of a vast tree. It was close beneath a deep crevice or chink in the tree, across which this species weaves a dense web, open for its exit and entrance at one end. In the present instance, the lower part of the web was broken, and two pretty small finches were entangled in its folds; the finch was about the size of the common Siskin of Europe, and I judged the two to be male and female: one of them was quite dead, but secured in the broken web; the other was under the body of the spider, not quite dead, and was covered in parts with the filthy liquor or saliva exuded by the monster. I was on my return from a day's excursion by land, at the time, with my boxes full of valuable and delicate insects, and six miles from my house, and therefore could not have brought the specimens home, even had I wished, which I did not, as the species was a very common species, easily to be procured nearer home.

"If the *Mygales* did not prey upon Vertebrated animals, I do not see how they could find sufficient subsistence. On the extensive sandy campos of Santarem, so bare in vegetation, there are hundreds of the broad slanting burrows of the large stout species (that fine one, dark brown, with paler brown lines down the legs). The campos, I know, from close research, to be almost destitute of insects, but at the same time they swarm with small lizards, and some curious ground-finches of the *Emberiza* group (one of which has a song wonderfully resembling our Yellow-bunting of England), besides which vast numbers of *Caprimulgi* (*C. psalurus*, Azara) and ground-doves lay their eggs on the bare ground. I believe this species of *Mygale* feeds on these animals and their eggs at night. Just at close of day, when I have been hurrying home, not liking to be benighted on the pathless waste, I have surprised these monsters, who retreated within the mouths of their burrows on my approach."

MYGALE EMILIA.

M. nigro-fusca, cephalothorace, duobusque articulis singulorum pedum late flavescenti-rubris.

Deep blackish-brown; the basal joint of chelicera with some scattered red hairs in front; the cephalothorax of a rich yellowish-red, the hairs short, close and velvet-like; the fourth and fifth joints of the legs clothed with yellowish-red hairs, the end of the fifth joint with many brown hairs; fourth joint of the first pair of legs, with the curiously hooked process near the end, also covered with red hairs, the under side of the fifth and sixth joints and the tarsi clothed with a close, dense, velvet pad. Body brown, with longish, scattered red hairs, which are deeper in hue than on the other parts.

July 8, 1856.—Dr. Gray, F.R.S., in the Chair.

ON THE LAND AND FRESHWATER SHELLS OF KASHMIR AND
TIBET, COLLECTED BY DR. T. THOMSON.

By S. P. WOODWARD, F.G.S.

These shells, which I received through Dr. J. D. Hooker and Sir Charles Lyell, were collected by Dr. Thomson in 1847–8, when he accompanied Major Cunningham and Capt. H. Strachey in “one of the most adventurous journeys ever made in the Himalaya *.”

The shells of continental India are nearly all distinct from those of Europe, and although far inferior in beauty and variety to those of the Asiatic Islands, have yet a marked character, owing to the admixture of tropical forms and especially to the great development of the operculated genera (*Cyclostomidæ*), which are almost unknown in our quarter of the world †.

It was, therefore, a matter of considerable interest to ascertain what land and freshwater shells occur in the remote regions of Kashmir and Tibet, and somewhat surprising to find, that of about 22 sorts collected by Dr. Thomson, one-half were British species, and the rest of the commonest and most widely diffused Indian forms.

The species marked * are European.

* *Helix pulchella*, small var., *subfossil*. Iskardo, Tibet (Europe, N. America).

* — *costata*, large var., recent. Iskardo, 7200 feet.

* *Helicella nitida*. Near Iskardo (Europe, N. America).

Bulimus candelaris, Pfr. Takht i Suliman, Kashmir.

— *segregatus*, small var. Kashmir.

* *Zua lubrica (subfossil)*. Iskardo (Europe, N. America).

Pupa Huttoniana, Benson. Iskardo (also *subfossil*).

* *Succinea Pfeifferi*, var. (*longiscata*, Morillet?). Kashmir.

* *Limnæa stagnalis*. Kashmir (Europe; N. America, Oregon).

* — *peregra*. Pitak, Tibet; Kashmir.

—, var. *Hookeri*. Iskardo and Nubra, Tibet (18,000 feet).

* — *auricularia*. Iskardo; Thogji Lake (*subfossil*).

—, sp. Kashmir (resembling the Australian *L. simulata*).

* — *truncatula*, Müll. Iskardo, in damp moss (also found at Candahar, Afghanistan; at Madeira, and in the U. States).

— *luteola*, Lam. (*succinea*, Dh.). Islamabad, Kashmir (also Prome, Burmah).

— *acuminata*, Lam. Jamu hills.

Planorbis Coromandelicus, Fabr. Jamu hills; Islamabad, Kashmir (also Ceylon and Malacca).

— *nanus*, Benson; *subfossil*. Tsoral Lake, Tibet (Capt. H. Strachey).

—, sp. Pitak and Iskardo; Tertse, Nubra, in lacustrine clay.

* Western Himalaya and Tibet; a Journey through the Mountains of Northern India. By Dr. Thomas Thomson. 8vo, London, 1852.

† Mr. Benson states that *Helix Bactriana* (Hutton), found in Afghanistan, is closely allied to the European *H. strigella*.

Paludina Bengalensis, var. Jamu hills, Kashmir.

**Valvata piscinalis* (subfossil). Kashmir; Tsoral Lake, Tibet.

**Cyrena fluminalis*, Müll. * (*Cashmiriensis*, Dh.). Avantipura, Kashmir.

Cyclas (*Pisidium*), sp., subfossil. Thogji Lake, Tibet.

These specimens have been submitted to the examination of Mr. W. H. Benson, who is unsurpassed in his critical acquaintance with Indian shells, and especially those of the Western Himalaya.

Helix pulchella and *Zua lubrica* were only obtained in the condition of "dead shells" from the alluvial plains of Iskardo and Kashmir.

The *Pupa* and *Bulimus candelaris*, *Limnæa auricularia* and *Valvata piscinalis*, were found both recent and subfossil.

Limnæa auricularia occurred in prodigious abundance in the alluvial clay around the salt-lake of Thogji, at the height of 150 feet above its present level. There are no longer any living shell-fish in its waters, and Dr. Thomson remarks, "it may fairly be inferred that the lake was quite fresh at the time when it was inhabited by *Limnæa*." The increase of the height of the surface of the water to the small amount of 150 feet, appears to have admitted of its discharging its waters along the course of an open valley into one of the tributaries of the Zamkar river (p. 173).

Everywhere to the northward of Tibet, from the Aral Sea to Chinese Tartary, is a country of small salt-lakes having no outlet; and this region divides Northern India from the Siberian steppes, in which land and freshwater shells of *Germanic species* are known to occur.

Westward, however, the ranges of the Hindoo Koosh are prolonged through Persia to the Caucasus, and form a continuous route to the Lusitanian region.

Since the shells which have been mentioned as English species occurring in Tibet, are also common to the South of Europe, they are rather to be regarded as *Lusitanian* than *Germanic species*.

The land species (*Zua*, *Helix*, *Helicella* and *Succinea*) are, however, amongst the most ancient inhabitants of this island, being found in the newer-pliocene deposits of the Thames valley, associated with the same *Valvata* and the same species of *Cyrena*, and with remains of an Elephant (*E. meridionalis*) and a Rhinoceros (*R. leptorhinus*), which are not only extinct, but were succeeded by other races of the same animals (*Elephas primigenius* and *Rhinoceros tichorhinus*), before they finally disappeared from this portion of the globe.

If, therefore, the small land shells of our newer tertiaries originally migrated into this country from the East, we must ascribe to their occupancy of the lofty plains of Kashmir and Tibet a very high

* Varieties of this shell are found in Sicily, Palestine, the Nile, and all the rivers of the East. These varieties have been regarded as constituting about twenty distinct species; e. g. *C. Euphratica*, Bronn; *ambigua*, Dh.; *Cor*, Lam.; *concolorina*, Caill.; *triangularis*, Dh.; *Panormitana*, Bivon, &c. When fossil, it is the *C. trigonula*, Searles Wood; *C. Gemmellarit*, Phi.

antiquity compared with any of the monuments which Man himself has reared, even in the country most usually regarded as the cradle of his race.

ON THE SPECIES OF THE AMERICAN GENUS *PARRA*.

By PHILIP LUTLEY SCLATER, M.A., F.Z.S.

The American birds of the genus *Parra*, together with their representatives in the Tropics of the Old World belonging to the genera *Metopidius*, *Hydralector* and *Hydrophasianus*, constitute a very natural group, allied in many respects to the *Rallidae*, but remarkable for the extreme elongation of the toes—a formation beautifully adapted for enabling them to walk upon the floating leaves of the numerous water-plants of these countries.

MM. Verreaux of Paris have kindly furnished me from their well-stored magazines with a series of specimens of *Parra*, which enabled me to point out to the Society the distinctions between all the hitherto known species of this genus, and to indicate one certainly new, and a second, which although not so obviously distinct, has some claim to be recognized as an intermediate species.

A. *Species caruncula frontali bilobata et caruncula rictali utrinque præditæ.*

1. *PARRA JACANA.*

Parra jacana et variabilis, Linn. et Gm.

Parra nigra et brasiliensis, Gm.

Parra jacana, Max. Beitr. iv. 786.

Parra jassana, Schomb. Reise, iii. 759.

Jacana du Mexique, Buff. Pl. Enl. 322 (adult).

Jacana du Brésil, Buff. Pl. Enl. 846 (juv.).

Capite toto cum cervice supra et corpore infra nigris : dorso, alis caudaque clare castaneis : tectricibus caudæ superioribus purpurascente tinctis : remigibus flavescenti-viridibus, nigro extus partim marginatis : hypochondriis et tectricibus subalaribus intense castaneis.

Hab. South-eastern Brazil (*P. Max.*); British Guiana (*Schomb.*); Cayenne; ins. Trinidad.

The examples of this bird which I have seen from Guiana and Cayenne appear to be considerably inferior in size to the Brazilian specimen, but I am not yet certain how far this may be due to sexual differences.

2. *PARRA INTERMEDIA*, sp. nov.?

"*Parra intermedia*, Bp.," J. et E. Verreaux, MS.

Capite toto cum cervice supra et corpore infra nigris : dorso, alis caudaque obscurius castaneis, purpurascente paululum tinctis. hypochondriis et tectricibus subalaribus brunnescenti-castaneis : remigibus flavescenti-viridibus, nigro extus partim marginatis.

Hab. Venezuela (*Verreaux*).

This bird is hardly distinguishable from the *P. jacana*, except by the browner and more purplish tinge of the back, in which respect it seems intermediate between that species and *P. melanopygia*.

I should hardly have ventured to separate it specifically on my own authority; but, as the MS. name has attained circulation, I think it right to point out the apparent differences.

3. *PARRA MELANOPYGIA*, sp. nov.

Capite toto cum cervice supra et corpore infra nigris : interscapulio, alis caudaque purpurascenti-brunneis : dorso imo et tectricibus caudæ superioribus nigris : hypochondriis et tectricibus subalaribus nigris remigibus flavescenti-viridibus, nigro extus partim marginatis

Hab. S. Martha in New Grenada (*Verreaux*).

MM. Verreaux's specimens of this bird are labelled *P. hypomelæna*, but that name is properly applicable to the next species.

4. *PARRA HYPOMELÆNA*.

Parra hypomelæna, Gray & Mitch. Gen. of B. pl. 159.

Nigra alis fusco-nigris purpurascente tinctis remigibus flavescenti-viridibus, nigro extus partim marginatis.

Hab. New Grenada, S. Martha (*Verreaux*), Bogota (*Mus Brit.*); Cartagena (*Mus. Paris.*); Chiriqui, Panama (*Bridges*).

B. Species caruncula frontali trilobata carunculis rictalibus nullis.

5. *PARRA GYMNOTOMA*.

Parra gymnotoma, Wagl. Isis, 1831, p. 517.

Parra cordifera, Less. R. Z. 1842, p. 135; Desmurs, Icon. Orn. pl. 42.

Capite toto cum cervice supra et infra ad medium pectus nigris, æneo micantibus : dorso toto alisque castaneis : uropygio purpurascente : abdomine purpurascenti-brunneo : remigibus flavescenti-viridibus, nigro marginatis.

Hab. Southern Mexico; Mazatlan (*Mus. Brit.*); Acapulco (*A. Lesson*); New Grenada, S. Martha (*Verreaux*); Honduras (*Dyson*).

Wagler's accurate diagnosis of this bird has been generally passed over, and Lesson's more recent appellation is commonly employed for this species.

November 11, 1856.—Dr. Gray, F.R.S., in the Chair.

ON A NEW SPECIES OF SQUIRREL (*SCIURUS MACROTIS*) FROM BORNEO. BY J. E. GRAY, Ph.D., F.R.S. ETC.

Among the specimens of animals which the British Museum has lately received from Mr. Wallace from Sarawak, is a large, well-marked species of Squirrel, particular for having very large, longish pen-

cilled ears like the European species, with a broad white streak on the upper part of each side, and a very broad full tail, grizzled, with large white tips to the hairs.

SCIURUS MACROTIS.

Ears large, with a large pencil of elongate hairs. Dark chestnut-brown, very minutely grizzled with pale tips to the hairs. Rump, outside of thighs and base of tail redder; point of thighs bright bay; feet blackish; upper part of the side with a broad pale streak; cheeks and inner side of legs paler; chin, throat, and beneath white; tail very broad, with very long white-tipped hairs.

Length 13, tail 11 = 24 inches.

Hab. Sarawak (*Mr. Wallace*).

OBSERVATIONS ON A LIVING AFRICAN LEPIDOSIREN IN THE CRYSTAL PALACE. BY J. E. GRAY, Ph.D., F.R.S. ACCOMPANIED BY A NOTE FROM MR. A. D. BARTLETT.

This animal has been exhibited for some months at the Crystal Palace, appears to be in good health, and has increased in size.

Mr. W. Hawkins, in the 'Illustrated News' (Supp. 20 Sept. 1856), which gives a very good figure of the animal from life, observes :—

"The three living specimens of this animal were brought to England from the Gambia, enclosed in balls of hard clay, where they had been for eight months without showing any signs of life, until those balls of hard clay were immersed in water, which caused the clay to crack and break up, discovering dark-coloured egg-like forms, which also presently burst, liberating their inmates, which briskly swam or rather dashed through the water, showing unmistakeable signs of life by feeding voraciously upon very large worms, small frogs and pieces of meat that were presented them."

The *Lepidosiren* uses its tail to propel itself forward and upward towards the surface of the water. The subulate limbs are very much elongated; the front ones are furnished with a narrow membranaceous margin of nearly equal width the whole length of the hinder edge; the hinder one has a narrow membrane on the middle of the outer side; they are exceedingly mobile and flexible, and are used by the animal to direct its motions, and are more like feet than fins, especially when they are within reach of some fixed body which the animal can use as a fulcrum.

There are two processes on each side over the base of the anterior members, which have been regarded as gills by some authors*; they are coloured like the rest of the body, and I could not discover, even when examined by a hand-magnifier of one inch focal length, that they were pervaded by any peculiar vascular structure, or furnished with any cirri or other processes usually found on the external gills of *Batrachia*. They scarcely moved during the time that I was examining the specimen, except when the animal was swimming, when they were used like the larger members, apparently to assist in di-

* See Peters, Ann. and Mag. Nat. Hist. xvi. 348.

recting its motions, and they evidently form part of the anterior members. They are placed rather close together somewhat above the base of the elongated finned filament. These limbs are used to support the animal some height above the surface of the gravel when it is at rest.

Indeed, all the motions of the animal much more resemble those of a *Triton* or *Lissotriton* than of an eel-shaped fish.

The upper and lower surfaces of the head are furnished with lines of mucous pores placed in a symmetrical manner on the two sides, similar to the pores observable on the head and chin of different kinds of fish, and of *Tritons* and *Lissotritons*: and there is a distinct continuous line of pores, like the lateral line of fish and *Tritons*, which is continued on the tail some distance behind the base of the hinder members, but becoming less distinct at the hinder part of the series.

The eyes are of moderate size, scarcely raised above the surface, round, without any eyelids; the pupil is black, small, circular, less than one-third the diameter of the globe, with a narrow golden iris.

The Mud Fish is generally to be observed swimming about under the water, or resting at the bottom of the tank, supporting itself by its members, an inch and a half or two inches above the surface of the gravel, with its nose generally in the corner, bent down and partly hidden in the gravel.

The mouth is firmly closed by the overhanging upper lip, except in front, where there is a small oblong, transverse, horizontal opening on the outer edge of the lips, admitting the water to the small, open external nostrils, which are on the middle of the under side of the upper lip. This opening does not extend to the hinder part of the lips, which are closed behind it, so that water cannot enter the mouth in that direction except through the nostrils.

In this quiescent state the lateral gill-opening is generally closed, but sometimes it is slightly elevated, and a small current appears to be emitted now and then from it, as if a small quantity of water were taken in by the nostrils and emitted by the gill-flap; but this action is not continuous nor very distinctly visible.

While remaining under the water the animal sometimes opens the mouth to its full extent, leaving it open for some time, dilating the throat by the action of the os hyoides; when fully dilated it closes its mouth, opens the gill-aperture, and contracting the throat emits a strong current of water through the lateral gill-aperture.

It occasionally but at uncertain periods rises perpendicularly to the top of the water, until the front part of the head and the whole mouth are exposed above the water; it then opens its mouth, which it retains open for a time, dilates its throat, as if taking in all the air it can contain, closes the mouth, descends under the surface and contracts its throat, as if it were forcing the air into the lungs (sometimes during this action one or two very small bubbles of air are emitted at the gill-aperture), and then the animal takes up its old position near the bottom of the vase.

I once saw the animal ascend and so take in air almost imme-

diately after it had been passing a fresh supply of water to its gills. When I have been observing it, it appeared to take in air more frequently than water *. It often rises with its body perpendicular, as if it were going to take in free air, but descends again without reaching the surface of the water.

The organs of respiration of this animal are twofold:—

1. Well-organized gills on the inner edge of the branchial arches, as in fishes, and a regular gill-cover with a small oblong aperture in front of the base of the anterior members (see Owen, Trans. Linn. Soc. xviii. t. 25. f. 3, t. 26. f. 1).

2. Two well-developed cellular lungs of nearly equal size (see Owen, Trans. Linn. Soc. xviii. t. 25. f. 3, t. 26. f. 1, 2).

3. The nostrils are close together, situated on the under side of the inner lip, with their internal opening on the side of the mouth between the lips and the outer edge of the large inner series of teeth; the passage is short, as a probe is easily passed from the one opening to the other, and the inner nostrils are very evident in the living animal when it opens its mouth to take in air.

M. Bischoff observed these interior nostrils also in the *Curamuru* or *Lepidosiren paradoxa* of the Brazils.

The animal is, therefore, provided with well-developed organs for both aerial and aquatic respiration, and its manner of breathing is perfectly conformable to this organization: it is consequently the most perfectly amphibious animal, equally adapted for living on land or in water, that has come under my observation.

The character which best separates the Batrachian—as the Toad, Frog and Salamander—from the Fish, is, that in both the larva and perfect state they are provided with an external and internal nostril, and it is through this nostril that these animals take in or emit the air which they respire; while in fish, the water which they respire is taken in by the mouth, and after passing over the gills is emitted by the lateral aperture of the gill-flap; the nostril being only a sac, without any communication with the cavity of the mouth.

When a Batrachian respire, the mouth is kept closed, the throat being used like a pair of bellows to force the air into the lungs; and if the mouth is kept open, the animal dies for want of the power of respiring. In fish, on the contrary, the mouth is always more or less open, the fish either constantly gulping in the water, then closing the mouth or lips, and emitting it by the lateral opening; or the mouth is partially open, and the animal uses its tongue and the hinder internal edge of the lip as a kind of valve, by which the cavity of the mouth is closed and the water is forced to pass through the gills.

* Mr. W. Hawkins in the 'Illustrated News' observes:—"It is seen habitually to rise to the surface of the water for a larger supply of atmospheric air, thrusting its open mouth above the surface."

Dr. Holbrook appears to have observed the same habit in the *Neofurus maculatus* (which is probably the larva of the Hell-bender or *Protonotaria horrida*). He states that that animal in confinement "ascends to the surface (of the water), taking in a mouthful of air, and sinks again with it to the bottom."—Amer. Herpet. i. 113.

The *Lepidosirens* appear to take in water by the nostrils, and at the same time to respire both air as Batrachians and water as fish.

The generality of the Amphibia, as the Toads, Frogs, and Efts or Salamanders, are organized for aquatic respiration in their young and lower state, and for aerial respiration in their adult condition; but this animal has both kinds of organs in a state fit for perfect use at the same time, and the animal evidently uses them simultaneously.

It appears to me that the Mud-fish is much more nearly related to the Amphibia than to any fish that I am acquainted with; at the same time it evidently forms a particular group in that class.

Dr. Daniel, who has lived for several years on the Gambia and on Macarthy's Islands, informs me that the *Lepidosiren*, like the Mud Eel or true *Siren*, is only found in the rice-fields, which are for more than half the year under water, and that they are only procured by the natives towards the end of the dry season, when they are dug out of the nearly-dried mud. They are eaten fried, and like eels have a rich oily flavour.

The habit of living in the mud is common to several Amphibia; thus the Mud-eel, or *Siren lacertina*, which has lungs and external gills, lives chiefly in mud, being dug out when the ditches of the rice-fields in Carolina are cleared. The Hell-bender or Mud-devil (*Protonopsis horrida*) and the Congo Snake (*Amphiuma*), which have internal gills and lungs and a small lateral gill-opening, live sunk in the mud often to the depth of 2 or 3 feet, especially in winter; and they and the *Siren lacertina* will live for some time out of water, and are said sometimes to leave it voluntarily.

Aquatic animals much more frequently bury themselves in the mud than is generally supposed. The common English Frogs and the large Efts bury themselves in the mud during the greater part of the winter, and this also is the case with *Dytisci* and other aquatic insects.

But some fish also, which have only gills adapted for aquatic respiration, have the same habit. Dr. Hancock observes, "When the water is leaving the pools in which they commonly reside, the Yar-row (a species of *Esox*, Linn.), as well as the round-headed Hassar (*Callichthys littoralis*), bury themselves in the mud, while all other fishes perish for want of their natural element, or are picked up by rapacious birds. The flat-headed Hassar (*Doras costata*), on the contrary, simultaneously quits the place and marches overland in search of water, travelling for a whole night, as is asserted by the Indians, in search of their object. I have ascertained by trial that they will live many hours out of water even when exposed to the sun's rays. Their motion over land is described to be somewhat like that of a two-poll'd lizard: they project themselves forward on their bony arms by the elastic spring of the tail exerted sideways; their progress is nearly as fast as a man will leisurely walk."—Zool. Journ. iv. 243.

"The Indians say that these fishes carry water within them for a supply on their journey. There appears to be some truth in this statement, for I have observed that the bodies of the Hassar do not

get dry like those of other fishes when taken out of the water ; and if the moisture be absorbed, or they are wiped dry with a cloth, they have such a power of secretion that they become instantly moist again ; indeed it is scarcely possible to dry the surface while the fish is living.”—*Loc. cit.* 243.

Dr. Hancock further observes, that a fish which he thinks is *Loricaria pleistomus* “is not only furnished with the common appendages for swimming, but also with four strong bony supporters, one attached to each of the pectoral and belly fins (*i. e.* constituting the first ray of each), by which the animal creeps on the bottom of the river, and perhaps where there is little or no water, also being as it seems partly amphibious.”—*Loc. cit.* 243.

From this account, it appears that the habits of these fish bear very little relation to those of the Mud-fish.

It is well known that many freshwater Mollusca which respire free air, and I believe some of those which are furnished with pectiniform gills for aquatic respiration, as *Paludina* and *Valvata*, in the warmer climates, such as India, where the waters of the streams or ponds are dried up, bury themselves in the mud to a considerable depth like the Mud-fish, and like them remain in a torpid state until the return of the rainy season.

Sir William Jardine has described the kind of cocoon in the clay in which the Mud-fish are brought to this country ; but I am informed by Mr. Bartlett that the cavity is always furnished with a small aperture opposite to where the nose of the animal is placed.

In referring this animal to the class of Fishes, authors have laid great stress on the fact of its being provided with a lateral line. Thus M. Duméril, in the last essay on the subject, notices the line, “which is ramified on the sides of the head as in *Chimera*,” overlooking the fact that the *Triton cristatus*, the common Eft, has similar lines on both the sides and head. He compares the gill-rays and branchial aperture to that of *Mormyrus* and *Cobitis*, but they are equally like those of *Protonopsis* ; and he compares the nostrils to those of the Lamprey, overlooking the fact that the animal is provided with nostrils communicating with the cavity of the mouth. See *Erp. Générale*, ix. 213.

I have been informed that this genus is found in other parts of Africa, as Senegal, where it is called *Tobal*, and the White Nile, from whence M. Armand sent specimens to the Paris Museum in 1843 ; and Dr. Peters found a species in Quillemanes, which Peters and J. Müller have called *Rhinocryptes amphibia*.

In reply to a note I had addressed to him, I have received the following interesting communication from Mr. Bartlett, who at the same time informed me that he intended to have communicated it to the next meeting of the Society :—

“Crystal Palace, Sydenham,
November 17th, 1856.

“DEAR SIR,—In reply to your note respecting the living Mud-fish, I beg to say that in the month of June last I received from

Western Africa a case containing four specimens of this animal; each specimen was imbedded in a block of *dry hard muddy clay*, about the size of a quartern loaf; these blocks of clay were each sewed up in a piece of canvas to prevent the clay crumbling or falling to pieces. According to the instructions I received from Capt. Chamberlayne (the gentleman who sent them), I placed them in a tank of fresh water at the temperature of 83 degrees; in doing this a portion of the clay crumbled off one of them and partly exposed the case in which the animal was contained; I was watching the operation when suddenly the *case or cocoon* rose to the surface of the water. I at first thought the animal contained in it must be dead, but I shortly afterwards observed a slight motion: apparently the animal was endeavouring to extricate itself, and this it soon afterwards accomplished by breaking through the side of its tough covering; it swam about immediately, and by diving into the mud and clay, which by this time had become softened, rendered it difficult to make further observations; I removed the case or cocoon, which still floated, and which I now send for your examination. On the following morning I found that two more of the animals had made their appearance; their cases however were not to be seen—they evidently remained imbedded in the soft clay. In the course of the next day the fourth animal suddenly floated to the surface enveloped in its case; as it showed no signs of life I removed it, and found the animal had been dead some time, as it was much decomposed. At the time these animals first made their appearance they were very thin, and about 9 inches long; they began to feed immediately upon *earth-worms, small frogs, fish, &c.*, occasionally taking raw flesh. I saw them sometimes attack each other, and one of them (I imagine in endeavouring to escape) leaped out of the tank into the large basin in the Crystal Palace in which the tank was standing (this specimen is still at large among the water-lilies, &c.). The remaining two lived together for some time, apparently on good terms; but in the month of August the one now remaining in the tank seized its companion and devoured nearly half of it, leaving only the head and about half the length of its body. In feeding, this creature masticates the food much, frequently putting it forward almost quite out of its mouth and then gradually chewing it back again, and often (when fed upon raw flesh), after having so chewed it for some time, it will throw it out altogether. The growth of these animals is most extraordinary: in June, as I have before stated, they were about 9 inches long; in three months they attained their present size, which cannot be less than 18 inches in length. It rises frequently perpendicularly to the surface to breathe, and at other times it supports itself on its fin-like appendages, and with the aid of its tail raises its body from the ground, the fins being bent or curved backwards. The movement of this animal is generally very slow, and would give one an idea that it was very sluggish; this however I have good reason to know is not the case, as in attempting to capture the one at liberty in the large basin it darted away with the rapidity of an arrow. I have reason also to believe the animal finds its food as much by *scent as sight*. With

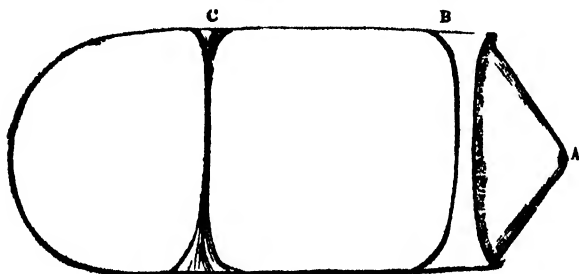
reference to the cocoon which I herewith send for your examination, the end covering the nose of the animal is rather pointed, and has an aperture about the size of a pin's head, which I have no doubt enables the animal to breathe during its state of torpor. The animal when in its case is coiled nearly twice round, and I observed in each of the blocks of clay a small hole about the size of a mouse-hole, which was quite smooth on the inside, as though the animal had crept through it.

"I am, dear Sir,

"Faithfully yours,

"A. D. BARTLETT."

Cocoon of the Mud-fish (Lepidosiren annectens).



A. Breathing-hole at nose.

B. A thin partition.

C. An attaching band that passes through the space where the animal bends, as in *a*. fig. D.

Fig. D.



D. A sketch of the animal in the cocoon.

a. The position of the band C.

b. The head, nose and eyes.

July 8, 1856.—Dr. Gray, F.R.S., in the Chair.

ON SOME NEW SPECIES OF BIRDS COLLECTED BY M. AUGUSTE SALLÉ IN SOUTHERN MEXICO. BY PHILIP LUTLEY SCLATER, M.A., F.Z.S.

1. *CERTHIOLA MEXICANA*.

Nigricanti-fusca : capite, alis caudaque nigris : superciliis et speculo alari albis : uropygio flavicante : gutture cinereo : abdomine flavo ; crisso albidioro : rectricibus extimis albo terminatis.

Long. tota 3·8, alar. 2·1, caudæ 1·2.

Sallé, no. 114. Some of the various local races of *Certhiola flavocula* certainly show such differences as entitle them to specific separation. The present bird does not appear to be quite the same as any of the nine given by Prince Bonaparte in his 'Notes Orn.' p. 51.

It is very closely allied to the Bogota species, which I believe to be the *C. luteola*, Cab., but may be distinguished by its duller back, less brightly-coloured uropygium and belly, longer bill and shorter wings.

2. ANABATES RUBIGINOSUS.

Saturate brunneus; pileo obscuriore: alis extus, uropygio et cauda tota cum pectore saturate rubiginoso-rufis; gula clariore: ventre dorso concolore sed medialiter pallidior: tectricibus subalaribus clare rubiginosis: rostro forti, crasso, recto, nigricante, basi pallida: pedibus nigricanti-plumbeis.

Long. tota 8.0, alæ 3.7, caudæ 3.3, rostri a rictu 1.2.

Sallé, no. 102. Cordova.

This fine *Anabates* is of the same strong form as *A. ferruginolentus* (Max.), but has shorter wings and rather a stiffer tail. I know of no species that resembles it much in colouring.

3. ANABATES CERVINIGULARIS.

Supra saturate brunneus; pileo nigro: dorso summo nigricante adumbrato: plumis medialiter pallidioribus: loris, superciliis longis et cervicis lateribus clare rufis: gutture dilutior, pallide cervino: abdomine flavescenti-brunneo lateraliter obscuriore: alarum pennis nigris extus brunneo limbatis, subtus autem cum tectricibus subalaribus clare rufis: uropygio et crasso cum cauda tota saturate rubiginoso-rufis: rostro validiusculo, recto, corneo, basi autem flavicante: pedibus pallide brunneis.

Long. tota 7.5, alæ 3.6, caudæ 3.0.

Sallé, no. 104. Cordova.

This species is not quite so strong in form as the last, and has not so thick a bill. In colouring it somewhat resembles *A. atricapillus*, but is much larger than that bird. The sexes are coloured alike.

4. ANABAZENOPS VARIEGATICEPS.

Supra brunneus: pilei pennis olivaceis, nigro angustissime circumcinctis et scapis plumarum flavicantibus: superciliis longis rufis: loris et regione auriculari nigris: mento et gutture toto ochraceo-albidis: abdomine pallide brunneo: cauda clare rubiginoso-rufa: tectricibus subalaribus flavicanti-ochraceis: rostro pallide corneo, basi flavicante: pedibus pallide brunneis.

Long. tota 6.0, alæ 3.3, caudæ 2.7.

Sallé, no. 204. Cordova. Sexes alike.

This bird closely resembles *Anabazenops rufo-superciliatus* (Laf.), but may be recognised at once by the darker, browner back, and the variegated head, which in the latter species is of the same greenish brown as the back. In the present bird also there is not that decided mottled plumage on the breast observable in the other species, although there are slight indications of it on the sides of the neck.

5. XENOPS MEXICANUS.

Rufescenti-olivaceus, capite obscuriore, uropygio rufo: loris albi-

dis: stria superciliari angusta ochraceo-flavida: regione auriculari ochraceo-flavida, nigro mixta: penicilla utrinque sub regione auriculari alba: subtus dorso similis sed minus rufescentia, mento et gutture medio ochraceo-albidis: alis nigris: vitta lata per remiges cum secundariorum interiorum marginibus et terminationibus necnon secundariis dorso proximis rufis: cauda rufa: rectricibus duabus utrinque submedialibus omnino et rectricum his proximarum parte basali nigris, duabus mediis et una utrinque extrema omnino rufis: rostro nigro, basi inferiore albicante: pedibus nigris.

Long. 4·6, alæ 2·7, caudæ 2·1.

Sallé, no. 115. Cordova.

Obs. Affinis *Xenopi genibarbi*, sed crassitie majore et colore subtus olivascens necnon gula ochraceo-albida distinguendus. ♂ et ♀ similes.

6. *SCLERURUS MEXICANUS*.

Brunnescenti-olivaceus, pileo paulo obscuriore; uropygio cum cer vice et pectore antice saturate rufis: mento albescentiore: alis nigris brunneo limbatis, rectricibus nigris, marginibus externis brunnescentibus: rostro nigro; basi inferiore albicante: pedibus nigerrimis.

Long. tota 6·5, alæ 3·2, caudæ 2·2.

Sallé, no. 101. Cordova.

M. Sallé's collection contains four examples of this interesting bird, which has never previously come under my notice. One marked as a female has the bill rather longer than the others, but does not otherwise differ from them. It may be at once distinguished from the Brazilian *S. caudacutus* (to which it shows great general resemblance) by its smaller size. Hartlaub's *S. fuscus* (R. Z. 1844, p. 370) seems to be larger, and differently coloured.

7. *SCYTALOPUS PROSTHELEUCUS*.

Supra brunneus, dorso rufescenti: superciliis longis albis: lateribus capitis nigris albo variegatis: subtus albus; lateribus cineraceis, ventre imo et crisso rufescentibus: alis fusco-nigris extus rufescenti-brunneo transvittatis: tectricum apicibus albo maculatis: cauda tota nigricante et rufescenti-brunneo tessellata: rostro nigro: pedibus brunneis.

Long. tota 3·8, alæ 2·2, caudæ 1·0.

Sallé, no. 112. Cordova.

This Mexican species much resembles in colouring a Bogota bird in my collection, which I somewhat doubtfully refer to *S. griseicollis*, Lafr., but differs from it in having the lower parts cinereous and not white.

8. *GRANATELLUS SALLÉI*.—"Setophaga salléi, Bp. et Solater;" Bp. Compt. Rend. 1856, May.

Ceruleo-plumbeus, superciliis vix obscurioribus: litura postoculari alba: genis gulæque plumbeo-fulvis: pectore et abdomine medio

cum crisso rosaceo-coccineis : lateribus postice albis : alis caudaque nigricantibus, plumbeo extus marginatis : rostro crasso, paululum incurvo, nigricanti-plumbeo ; vibrissis fere nullis : pedibus pallide brunneis.

Long. tota 5·2, alæ 2·4, caudæ 2·3.

Sallé, no. 129. Cordova.

This very pretty bird, of which M. Sallé only procured a single specimen, is, I think, upon reconsideration hardly to be placed in the genus *Setophaga*, although so closely resembling many species of that genus in its style of colouring. The bill is quite different from that of *Setophaga*, and is more like that of *Nemosia*, being even thicker than in some species of the latter form, but rather more incurved. The characters given by Prince Bonaparte for his genus *Granatellus* (founded upon a bird figured in an unpublished plate of DuBus' *Esquisses Ornithologiques*) seem to agree better with this bird, and from the description of the only species of that genus (which I have never seen) I cannot help thinking that it may have something to do with the present bird. I therefore place them for the present in the same genus.

9. PARUS MERIDIONALIS.

Supra cinereus : alis caudaque nigricantibus brunnescenti-cinereo limbatis : pileo toto cum nucha, gutture et cervice antica nigerri-mis : genis et capite laterali albis : abdomine cinereo brunnescente tincto ; pectore et ventre medio albidis : rostro nigro : pedibus plumbeis.

Long. tota 4·8, alæ 2·65, caudæ 2·3.

Sallé, no. 167. El Jacale.

This Titmouse is a very close ally of *Parus atricapillus* and *Parus carolinensis*. I am sorry I have not been able to compare it with authentic specimens of those species, but, as far as I can judge from Mr. Cassin's excellent synopsis of American Parinæ given in his 'Birds of California,' it would appear—as by the locality it comes from would seem most probable—to be distinct from either of those species.

From *P. carolinensis* it appears to differ in its greater size, being nearly half an inch longer than the dimensions assigned to that bird by Mr. Cassin. It would hardly seem likely that it is the same as *P. atricapillus*, which is an inhabitant of the more northern states of the Union, and the slightly inferior size and white medial line on the lower parts seem to distinguish it from that species.

10. FORMICARIUS MONILIGER.

Supra brunnescenti-olivaceus, colli lateribus et uropygio rufescentioribus, pileo nigricantiore : macula in loris triangulari alba : gutture toto nigro, infra vitta angusta rufa cincta : abdomine toto nigricanti-griseo, lateribus et crisso olivaceo perfusis : regione oculari nuda : tectricibus subalaribus ochraceis, nigro variegatis : caudæ parte apicali nigra : rostro nigro : pedibus clare brunneis.

Sallé, no. 105, 3 et ♀ similes. Cordova.

A typical *Formicarius*, a close ally of *F. cayanaensis*, *analis*, &c., but distinguished by its black throat, bordered beneath by a narrow band of rufous; white triangular spot on the lores; and other differences. It is the first of the form found to occur so far north.

11. TODIROSTRUM CINEREIGULARE.

Olivaceum: alis caudaque nigris, flavicante olivaceo limbatis: orbitis antice nigricantibus: loris albidis: subtus gutture et cervice cineris aut potius albis cinereo dense striolatis: pectore olivaceo: abdomine toto et tectricibus subalaribus flavis: rostro compressiusculo, crassiusculo; culmine carinato, incurvo; colore nigricante, tomis pallidis: pedibus pallide brunneis.

Long. tota 3·6, alæ 1·7, caudæ 1·2.

Sallé, no. 89, ♂. Cordova.

This *Todirostrum* differs slightly in the form of the bill from the ordinary members of the genus, that part being rather thicker, and with the culmen elevated and more incurved than in the typical species of the group.

12. MUSCIVORA MEXICANA.

"*Megalophus mexicanus*, Kp.," Bp. MS.

Brunnea: uropygio, cauda tota et corpore subtus flavescenti-ochraceis, gutture albidiore: alis extus ochraceo punctatis et subtus (nisi primariorum apicibus) omnino ochraceis: crista ampla, aureo-flava, carulescente anteo terminata: rostro productiore quam in M. regia: pedibus flavidis.

Long. tota 6·0, alæ 3·3, caudæ 2·8, rostri a rictu 1·3.

Sallé, no. 78. Cordova.

M. Sallé's collection contains a single example of this interesting bird, which however was not procured by himself, and is unfortunately not in very good condition. It is probably the *Megalophus mexicanus* of Dr. Kaup, which I have seen indicated in Prince Bonaparte's MS., but which I believe is merely an unpublished name. From the common *Muscivora regia*, to which it offers a close general resemblance, it may be distinguished by its longer bill, and having the base of the crest of a paler yellowish tint, and the tips with less purplish colouring.

The *Muscivora castelnauii* (*Onychorhynchus castelnauii*, Deville, R. Z. 1849, p. 56), the only other member of the genus hitherto known, from Eastern Peru, on the other hand appears to have a shorter bill and more reddish crest than the typical species.

13. TYRANNULA SULPHUREIPYGIA.

Olivacea: pilei crista mediali flava: uropygio pallide sulphureo: alis caudaque nigris, secundariis extus brunnescente limbatis: subtus flavicanti-brunnea, gula et ventre medio flavis.

Long. tota 5·2, alæ 2·8, caudæ 2·3.

Sallé, no. 84. Cordova.

Obs. Aff. *T. barbata* ex America Meridionali, sed statura majore, colore uropygii pallidior et corporis subtus brunnescentiore distinguenda.

14. *ELÆNIA VARIEGATA*.

Supra brunnea, olivascens tincta, marginibus plumarum pallidioribus : alis caudaque nigricantibus, illarum tectricibus extus albo marginatis : pileo et capitis lateribus nigris : crista mediali flava : superciliis a fronte circum nucham conjunctis, albis : subtus pallide flava, gutture albo, striga utrinque rictali nigra : pectore nigricante flammulato : rostro et pedibus nigris.

Long. tota 6·2, alæ 3·7, caudæ 2·6.

Sallé, no. 80. Cordova, ♂ et ♀ similes.

Obs. Affinis *Elæniæ albicollis* (Vieill.) ex America Meridionali sed crassitie majore : coloribus lætioribus.

15. *PIPRA MENTALIS*.

Nigra : capite toto cum nucha coccineis : mento summo tibiisque plumosis et tectricibus subalaribus flavis.

♀. *Pallide viridis, subtus paulo dilutior.*

Long. tota 4·0, alæ 2·3, caudæ 1·1.

Sallé, no. 171. Cordova.

This Manakin is a beautiful Mexican representative of *P. rubricapilla* and *P. chloromeros*. From the former it may be distinguished by its yellow thighs, from the latter by its yellow chin and under wing-coverts.

16. *MYIADESTES UNICOLOR*.

Hypothymis cæsia, Licht. in Mus. Berol.?

Schistacea unicolor, subtus pallidior, ventre albicantiore : remigibus nigris, harum autem (nisi trium extimarum) basibus alula spuria partim celatis, cum marginibus ipsarum et secundariarum apicem versus externis brunnescenti-oleagineis ; hoc colore intus sub ala albidior : cauda nigra ; rectricibus duabus mediis schistaceis, harum duarum utrinque extimarum parte apicali pallidior et apicibus ipsis cum margine interna apicem versus albis : rostro et pedibus nigris.

Long. tota 7·5, alæ 3·8, caudæ 3·4.

Sallé, no. 150. Cordova, ♂ et ♀ similes.

This bird is certainly quite distinct from Lafresnaye's *M. obscura*, of which I possess examples from Guatemala. Judging from Audubon's plate and description it likewise would seem different from *P. townsendi*, which has been united to Lafresnaye's species, I believe quite erroneously, by Prince Bonaparte.

My impression is that the Berlin Museum specimens, marked "*Hypothymis cæsia*," are identical with the present bird ; but as I have no means of verifying that fact, and the name is merely in MS., I think it safer to give it a new appellation.

Lafresnaye's *M. obscurus* (R. Z. 1839, p. 99), of which I have examples procured near the city of Guatemala by Signor Constancia, may be recognized at once from the present species by its brown back and rufous wing-edgings.

BOTANICAL SOCIETY OF 'EDINBURGH.

April 9, 1857.—Professor Balfour, Vice-President, in the Chair.

The following papers were read :—

1. "On the Effects of a Solution of Bicarbonate of Ammonia in promoting Vegetation," by C. J. Burnett, Esq.

The author stated, that the carbonate of ammonia had been recommended as existing in the refuse-liquor of gas-works, on account of the comparative cheapness of the ammonia in this form, but that he was inclined to recommend the carbonates of ammonia also on other very important grounds ; viz.—that the compound of ammonia with carbonic acid was the most natural of all the ammonia manures, and that, in converting it into the sulphate and other salts commonly sold for manure, we drive off a most important element of plant-food, of much more universal value than the sulphuric or other acid by which it was replaced. For healthy growth, a proper proportion of carbon should accompany the nitrogen added ; and we should not attempt to dis sever those substances which Nature had shown such an evident desire to associate in their application to plants. Instead of driving off the carbonic acid, he would recommend adding more of it, so as to convert the monocarbonate, or mixture of carbonates, into a more fixed and more nutritious bicarbonate. Till a cheap form of bicarbonate, corresponding to the other agricultural salts, should be in the market, a solution of the proper nature might be easily and conveniently made by any one, by saturating with carbonic acid evolved from muriatic acid and chalk or limestone a solution of the common carbonate, or perhaps the common gas-liquor. The manufacture was one which any farmer or gardener could readily carry on with two barrels and a bent piece of lead tube ; and the solution might be carried to the field in barrels, and applied by a rose or pierced tube. The solution should be very dilute when applied.

To make more clear the particular object for which he now recommended the use of this manure, he would say a word or two on the different natures and applications of manures in general. They might be divided into two classes :—1st, Manures which afforded ingredients of plant-food which could be supplied by the soil alone ; 2nd, Manures which supplied ingredients which were also contained in the air. As to the first class, whether (as in the majority of instances) required during the whole period of plant-growth, or merely in its latter stages (as phosphates in case of corn crops, &c.), they should be added in a quantity sufficient for one crop at least, and in a sparingly or gradually soluble form, to prevent serious loss from their being washed down out of reach of the roots. As to the second class, however, the case was very different indeed. Though the carbon and nitrogen which they supplied were essential elements of plant-food at every stage, yet, as it was only in the earliest stages that the earth was their only source, and as it was manifestly bad economy to pay money for what you could have for nothing, the use of manure of this class should be principally confined to the

plant in the earliest stages of growth, and then made with the view of giving the plant such a start as would enable it to draw, at an earlier period than it otherwise would, on the unlimited and untaxed supplies of carbon and nitrogen which our atmosphere provides. He could not doubt that one pound of nitrogen and carbon applied at the critical period, so as to lift the plant expeditiously out of helpless infancy and entire dependence on mother earth into comparative independence, drawing still gratefully on earth for what she alone could supply, but able to forage for much in free air, would, at the seasons when harvest arrived, be found to have produced a much larger addition to our crop than the same pound protractedly doled out as a supplementary supply during the entire period of growth by the decay of organic matters in the soil. He would recommend the application of the bicarbonated ammoniacal solution to the young crop to be made during what the farmer most expressively terms growing weather, when the ground is moist enough to ensure its immediate penetration, and there is sufficient warmth and geniality in both air and earth. The author stated that he had made numerous and varied experiments with the bicarbonate during the last five or six years, on wheat, oats, beans, peas, &c., as well as roses, lupines, sweet peas, and many other garden plants, and that their results, along with the theoretical considerations alluded to, justified him in recommending the bicarbonated ammonia solution as deserving of a thorough trial both by farmers and gardeners.

2. "Does Magnetism influence Vegetation?" by H. F. Baxter, Esq. The author states as the result of his inquiry, that no positive evidence has been obtained to show that magnetism either does or does not influence vegetation.

3. "On *Lycium Mediterraneum*," by Dr. Thomas Anderson. After careful and repeated examination of specimens of *L. Edgeworthii* (Dunal), he is convinced that it is only a variety of *L. europæum* (Linn.).

4. "On the Applications of Botany to Ornamental Art," by Mr. George Lawson, F.R.P.S.

5. "Remarks on a Shower of Mud, which occurred at Corfu on the 21st of March, 1857," by Mr. George Lawson, F.R.P.S.

The day was squally and showery; the light showers brought down a great quantity of mud. On examining the surrounding fields, I found the trees and every other object covered with it. Was this native dust, or was it imported by aerial currents from Africa? From the state of the weather during the three previous days, I am led to favour the latter opinion.

6. "Register of the Flowering of certain Spring Plants in the Royal Botanic Garden, Edinburgh, from the 12th of March to the 15th of April, 1857, as compared with the five previous years," by Mr. James M'Nab.

GEOLOGICAL SOCIETY.

March 11, 1857.—Colonel Portlock, R.E., President, in the Chair.

The following communications were read :—

1. "On the *Dichobune ovina*, from the Upper Eocene of the Isle of Wight." By Professor Owen, F.R.S., F.G.S.

This paper comprised a detailed description of the lower jaw and teeth of an Anoplotherioid quadruped (*Dichobune ovina*, Owen), of the size of the *Xiphodon gracilis*, Cuvier, and belonging to the family that includes *Dichobune* and *Xiphodon*. The dental formula, as shown by these teeth, and by the evidence on their crowns of the presence of the teeth of the upper jaw, is the typical one in diphyodont mammalia, viz. incis. $\frac{2-3}{2-3}$, can. $\frac{1-1}{1-1}$, premol. $\frac{4-4}{4-4}$, molars, $\frac{8-3}{2-3} = 44$. Professor Owen, having described the differences of the species under notice from the allied species *D. cervinum*, concluded with some remarks on the relations of the genera *Xiphodon* and *Dichobune*, as illustrated by their dental organs: and pointed out that the small anoplotherioid *Microtherium*, so much in some respects resembling the Chevrotains of Java, &c., but possessing persistent upper incisor teeth, probably differed also from the Ruminants in having a still more simplified structure of the stomach than is presented even by the Chevrotains (*Tragulus*, in which the third bag or psalterium is suppressed). Thus nearly all of the known eocene artiodactyle herbivores are separable from the Ruminants; and of the very few that remain, the dental evidences are as yet incomplete. Further, the gradations of dentition displayed by the extinct even-toed hoofed herbivores above referred to go far to establish the natural character of the group *Artiodactyla*.

2. "On two species of the fossil Mammalian genus *Plagiaulax* from Purbeck." By Dr. H. Falconer, F.R.S., F.G.S.

The author first alluded to the interesting relics of Mammalia (*Spalacotherium*) discovered some time since by Mr. W. R. Brodie, in the cliffs of Durdlestone Bay, near Swanage, and described by Professor Owen in the Journal of the Society (vol. x. p. 420, &c.). He then mentioned that Mr. Brodie had since made some important additions to this Purbeck fauna (including the *Triconodon*); and that Mr. S. H. Beckles had more recently obtained numerous additional evidences of mammalian animals (chiefly in the condition of lower jaws), besides various valuable reptilian remains in the same thin freshwater deposit which had yielded the fossil above referred to, and was still energetically occupied in the research. Among the specimens found by Mr. Beckles, are some portions of the lower jaws of two species of a mammalian genus, which is best represented among existing forms by the *Hypsiprymnus* or Kangaroo-rat. Dr. Falconer names the fossil genus *Plagiaulax*,—an abbreviation for "*Plagiaulacodon*," from *πλάγιος* oblique, and *αὐλὴ* groove; having reference to the diagonal grooving of the premolar teeth. With regard to these two species (*P. Becklesi* and *P. minor*), satisfactory evidence has been obtained as to the characters of the

lower jaw: the dental formula being—incisors, $\overline{1-1}$; canines, $0-0$; premolars, $\overline{3-3}$ and $\overline{4-4}$; molars, $\overline{2-2}$; = 12 and 14 in all. The author then entered into a very full detailed description of the teeth and jaw in each of the two species. *Plagiaulax* characteristically differs from *Hypsiprymnus*,—1st, by the obliquity of the grooves on its premolars, the latter genus having the analogous teeth vertically grooved; 2ndly, by having only two true molars in each ramus of the jaw, instead of the usual four and occasional three, belonging to recent marsupials; 3rdly, by the considerable salient angle which the surfaces of the molar and premolar teeth form, instead of presenting a uniform level line; 4thly, by the very low relative position of the articular condyle. In *P. Becklesii* the two incisor teeth were large and robust, projecting upwards at a considerable angle, and the ramus of the jaw was remarkably short and deep. In *P. minor* the incisors were more slender, pointing less suddenly upwards, and the ramus was narrower and more curved. Dr. Falconer more especially infers the marsupial characters of the genus,—1st, from its Hypsiprymnoid resemblances in the grooved premolars and the relative size and position of the incisors; 2ndly, from the raised and inflected fold of the posterior and inner margin of the ramus; 3rdly, the form and characters of the symphyseal suture.

The author dwelt upon the peculiarly small number of the true molars in this genus,—presenting, as it does, a marked special suppression in these organs, and so offering the most *specialized* exception, amongst the marsupials, fossil or recent, from the hitherto accepted rule of the older vertebrate forms presenting the least departure from the archetypal plan. He noticed also the interesting fact, that the crowns of the molars of *Plagiaulax* presented an unmistakeable and close resemblance to those of the minute teeth of the *Microlestes* from the Triassic Bone-bed of Wurtemberg. Lastly, Dr. Falconer alluded to the fact of little lower jaws and small isolated bones forming so large a proportion of the mammalian remains from this thin Purbeck freshwater bed; whilst more or less perfect skeletons of aquatic or amphibious reptiles occurred in the same deposit; and he stated that not only had he observed that in the tanks in India the bones of small animals were uniformly wafted to the margin, but that M. Lartet had lately pointed out to him that in the rich Falunian deposit of Sansan, the skeletons of the large terrestrial animals were found in certain parts of the lacustrine beds, whilst in other parts, probably the old marginal deposits, the little bones of frogs, shrews, &c., could be collected by the handful. The author could not therefore but hope that further explorations, by opening out the stratum where it was originally deposited in deeper water, would yield even richer supplies of still larger mammals.

March 25, 1857.—Colonel Portlock, R.E., President, in the Chair.

The following communications were read:—

1. "On some Fish-remains from the neighbourhood of Ludlow." By Sir P. G. Egerton, Bart., M.P., F.G.S.

This paper comprised descriptions of some specimens of fossil

fishes discovered by Mr. Salwey in the Old Red Sandstone of Acton Beauchamp, and others by Mr. Lightbody in the upper bone-beds near Ludlow. From the first-named locality the author described a portion of a cephalic carapace, indicating a large and new species of *Cephalaspis* (*C. Salweyi*). Another new species of *Cephalaspis* (*C. Murchisoni*) was founded on two specimens obtained by Mr. Lightbody in a bed below the paper-mill on the river Teme at Ludlow; and a third new species (*C. ornatus*) was described from specimens from dark micaceous shales in the Hereford Railway Cutting at Ludlow. The same shales have afforded two specimens of a very small Cephalaspid of great interest. These are of the size of a four-penny piece, and have a general resemblance to *Cephalaspis*, except in the peculiarity of having behind the cephalic shield, and united to its posterior margin by a distinctly marked suture, a broad plate divided into lateral halves by a prolongation of the occipital crest. The author, having stated his reasons for regarding these specimens as adult and not embryonic individuals, gave this new Cephalaspid form the generic title *Auchenaspis* (on account of its *nuchal* plate), and described it under the specific name of *A. Salteri*. In conclusion, some other ichthyic remains, referable to *Plectrodus* and *Onchus*, were enumerated as having been collected by Mr. Lightbody in the railway-cutting and in the River-bed near Ludlow.

MISCELLANEOUS.

Observations on the Generation of the Arachnida.

By E. BLANCHARD.

SINCE Bonnet's experiments on the *Aphides*, naturalists have frequently paid attention to the faculty attributed to the females of certain articulated animals, of engendering without the aid of any male. Thus it has been asserted that some female spiders, kept in captivity and isolated, frequently deposited fertile eggs, and that these broods might succeed one another for several years. From this observation it appeared natural to conclude that in this case the males were not always of indispensable utility in the continuation of the species. In connexion with this, one of the results of my investigations into the anatomy and physiology of these animals appears to me to be worth recording.

It is very true that female spiders, when isolated in boxes, furnish eggs which are soon hatched, and this after a captivity of three or four years. Specimens of *Mygale* sent from Montpellier to Paris, and each contained in a separate box, have repeatedly furnished me with a great number of young ones. A *Segestria* (*S. perfida*, Walck.) which I have kept alive for more than three years, produced young the year before last, and again last year; hardly a month ago hundreds of the young were still living. Another form of the order *Araneida*, a *Filistata bicolor*, which has also lived for three years in my laboratory, constructed its nest some months ago, and soon afterwards gave birth to a considerable quantity of young individuals which are still alive.

Such facts as these certainly appear at first sight to allow us to

think that in the *Araneida* production by virgin females takes place, and that fecundation by the males is unnecessary, at least under all circumstances. But to get at the knowledge of the truth, it is often very useful not to rest satisfied with a single set of observations. The examination of the generative organs of the *Araneida* in fact gives the most complete explanation of these productions by females kept in captivity for several years.

Amongst the *Araneida* we must distinguish between those whose life only lasts one season, and those of which, on the contrary, the existence is prolonged far beyond this term. In the former a single oviposition takes place; in the others, the broods succeed each other from year to year without the concurrence of the males; only, as is shown by attentive observation and experiment, the concurrence of the male is necessary at least once.

Mygale, *Clotho*, *Filistata*, *Segestria*, &c., all belong to the category of species which usually live several years; in all, leaving out of consideration certain secondary modifications, the female apparatus is composed of two large tubes, sometimes united at the extremity, sometimes isolated and terminated by a caecum, to which the ovarian chambers are appended. At the moment of copulation these tubes receive the seminal fluid in abundance; they are true spermatric reservoirs; the eggs, on the point of being expelled, are impregnated during their passage. The fecundating liquid not being exhausted by a single oviposition, and being preserved with all its qualities in its reservoirs, as I have repeatedly ascertained by microscopic examination, new ovipositions may take place at longer or shorter intervals, without any necessity for fresh copulations.

The study of the arrangement of the generative organs, and the ascertainment of the presence of spermatozoids in the large ovarian conduits, prove convincingly that the female *Araneida* are not fitted to furnish fertile products, except after copulation. But this kind of proof is not the only one to which I have turned my attention. Keeping in captivity spiders of different kinds, especially of the genera *Mygale* and *Filistata*, which had not acquired their full development, I have succeeded, in many cases, in feeding them up to the term of their growth; these individuals, taken young, had certainly never received the approaches of the male, and the eggs obtained from them always remained barren.—*Comptes Rendus*, 6 April 1857, p. 741.

On the Brain of the Dytici, in its relations to Locomotion.

By E. FAIVRE.

The following experiments have been made upon a great number of *Dytici*, both males and females, with the view of ascertaining the relations of the cerebral ganglia to the locomotion of the animals.

1. *Total or partial removal of the supra-oesophageal ganglion.*—If the whole of the supra-oesophageal ganglion be removed from a *Dyticus*, the animal remains motionless for some moments, without giving any signs of great pain. It soon begins to walk straight forward, but with much greater difficulty than in the normal state; it

swims more readily than it walks. Moving always in the same direction, it is constantly striking against the same point of the vessel in which it is kept. In general it scarcely survives the operation twenty-four hours.

When one of the lobes of the supra-oesophageal ganglion of a *Dyticus* has been removed, the power of walking is diminished, but the animal still swims with great celerity. In either case the insect always moves towards the uninjured side, so that it describes interminable circles in the same direction. Thus, when deprived of one of its lobes, the *Dyticus* loses the power of directing itself towards the side of this lobe, from which we may conclude that each lobe presides in the direction of its side.

2. *Total or partial removal of the sub-oesophageal ganglion.*—When this ganglion is entirely removed, the *Dytici* are totally incapable of swimming or walking. This is not owing to the paralysis of any of the legs, for each member moves spontaneously and draws back when pinched. The ambulatory feet are even seen to move, as if to walk, and the natatory feet as if to swim. But the insect only moves accidentally; it neither walks nor swims.

The exciting power of its motions, and that by which they are coordinated, cease with the removal of the sub-oesophageal ganglion. The insect raises itself on its feet, it advances an ambulatory foot with a natatory one, or even the natatory feet of one side, and this disagreement produces no result.

These observations lead to the following results:—

The supra- and sub-oesophageal ganglia and the peduncles which unite them, represent the brain of the *Dyticus*, and exert an incontestable influence upon locomotion.

The upper part of the brain, placed above the oesophagus, is the seat of volition and of the direction of the movements.

The lower part is the seat of the exciting cause and of the coordinating power.—*Comptes Rendus*, 6 April 1857, p. 721.

On Spirochaetopterus, a new genus of Annelides from the Coast of Norway. By M. Sars.

SPIROCHAETOPTERUS, Sars.

Corpus filiforme, antice truncatum ibique infra et ad latera labium formans carnosum spathulatum seu infundibuliforme, in cujus fundo os. Lobus capitalis supra os, parvus, rotundatus, oculis nullis. Cirri tentaculares duo longissimi et sulco longitudinali ornati. Segmenta novem antica corporis depressa, brevia, mamillis pedalibus conicis seu pyramidalibus solummodo dorsalibus (ventralibus carentibus), setis instructis capillaribus apice subhastato-acuto non in fasciculum congestis, sed seriem transversam seu ad longitudinem mamillarum formantibus, segmentum quartum etiam seta validissima apice oblique truncato et denticulo ornato.

Segmentum decimum et undecimum subteretia, longissima, pinnis seu mamillis pedalibus foliaceis ornata, scilicet una dorsali fasciculum

setarum capillarium non exsertilium includente et duabus ventralibus absque setis.

Segmentum duodecimum et omnia sequentia (quorum numerus fere 130-140) subteretia, anteriora longa sensimque posteriora breviora, pinna dorsali conica vel subcylindrica apice globoso et fasciculo setarum capillarium instructa, ventrali duplici ut in segmento 10mo et 11mo, et absque setis.

Animal in tubo inclusum erecto, longissimo, cylindrico, pergamentaceo, tenuissime transverse sulcato seu annulato, extremitate inferiore affixo.

Spiochaetopterus typicus, Sars. Unica species (pp. 7-8).

The remarkable genus *Chaetopterus*, Cuvier, has hitherto occupied an isolated position amongst the other Annelides. Audouin and Milne-Edwards in 1833 established it as a distinct family (*Chaetopterea*), and their example has been followed by all subsequent authors. But there has always been a doubt as to its true place in the system and its affinities with other Annelides. The above-mentioned French zoologists even thought that it would be most natural to form a distinct order for this animal, but they placed it, evidently incorrectly, between *Peripatus* and *Arenicola*. Grube (in 1850) was not more fortunate in placing it between *Siphonostomum* and *Arenicola*. Lastly, R. Leuckart (in 1849) was the only person who prognosticated the family to which the genus *Chaetopterus* should belong, namely the *Ariciea*.

This new animal forms a remarkable connexion between *Chaetopterus* and *Spio*. It has only been taken at Helle, in the neighbourhood of Manger, near Bergen, in mud at a depth of 40-50 fathoms in company with *Virgularia mirabilis*, Müll.—*Fauna littoralis Norvegiæ*, Second part, 1856, pp. 1-8.

On the Sea Sawdust of the Pacific. By JOHN DENIS MACDONALD, Esq., Assistant Surgeon R.N.

The Author gives a description of the remarkable little Alga so frequently met with in the South Pacific, scattered over the surface of the water in broad streaks and patches of a pale yellowish-brown tint, and which is known under the name of "Sea Sawdust."

After adverting to the occurrence of a similar phenomenon in other parts of the globe, and citing the account given of the *Trichodesmium erythraeum* of the Red Sea by MM. Evernor Dupont and Montagne, together with a description extracted from the 'Colombo Herald' of May 14, 1844, of what was obviously an example of a vegetable scum of the same kind occurring on the sea off Ceylon, the author remarks, that in the instances met with by himself he did not recognize the foetid odour so generally and pointedly spoken of in the accounts of others. He then states the results of his own observation as follows:—

"It was rather difficult at first to determine whether our species is to be referred to the Oscillatoridæ or the Confervidæ. In the latter,

a linear series of tubular cells compose the filaments, which are thus said to be jointed; but in the former, although the filaments are tubular, simple and continuous without actual joints, a pseudo-jointed appearance is presented by the apposition of the little masses of contained colouring matter. Notwithstanding, having submitted the 'sea saw-dust' of the Pacific to microscopic examination on several occasions, I was much inclined to believe that the filaments were actually jointed; and this view is supported by the circumstance that an empty tubule, or one in which the parietes may be traced continuously without being interrupted by joints or internal septa, has never fallen under our notice; besides which the filaments are exceedingly brittle, usually suffering cleavage in the transverse direction. It, however, undoubtedly belongs to the *Oscillatoridæ*.

"When the filaments are first removed from the water, they may be observed adhering side by side in little bundles or fasciculi; and besides the colouring matter, the little cells, or at least the intervals between the septa, contain globules of air, which sufficiently account for their buoyancy; and, moreover, in this respect, although their abiding place is the open ocean, their habit can scarcely be regarded as very different from that of those species which flourish in damp localities exposed to the atmosphere.

"The filaments are all very short compared with their diameter, with rounded extremities; and when immersed some little time in fluid so that the contained air-bubbles make their escape or are taken up, the pale colouring matter appears to fill the cells completely, and a central portion, a little darker than the rest, may be distinctly perceived in each compartment intersected by a very delicate transverse partition.

"We have found this species off the coast of Australia and in Moreton Bay, amongst the Polynesian Islands, and on two separate occasions off the Loyalty Group, in nearly the same geographical position."—*Royal Soc. Proc.* Feb. 26, 1857.

OBITUARY NOTICE.—DR. ROBERT BALL OF DUBLIN.

Our readers will regret to hear of the decease of this eminent Irish zoologist, which took place suddenly at his residence in Dublin on the 30th of March, in consequence of a rupture of the aorta. Dr. Ball has for many years been one of the chief students of zoology in Ireland, and although his published writings are not numerous, the frequent references to his observations to be found in the works of our principal writers on British animals, bear witness to his industry and the amount of his information.

Dr. Ball held several posts in Dublin, but he was best known to naturalists as Director of the Museum in Trinity College and Secretary to the Zoological Society of Dublin, of which he was the principal supporter. He was born at Cove, county Cork, in April 1802, so that at the time of his death he was scarcely fifty-five, and as his faculties were still in their full vigour, he has left a blank in the ranks of Irish naturalists which will not easily be supplied.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SECOND SERIES.]

No. 114. JUNE 1857.

XXXIII.—*Researches on the Development of the Pectinibranchiata.*
By J. KOREN and D. C. DANIELSSEN.

[Concluded from p. 366.]

Purpura lapillus (Buccinum), Linn.

THE capsules in which the eggs are enclosed somewhat resemble a little bottle, of which the convex bottom would be turned upwards, and the very slender neck directed downwards. It is by the lower extremity that they are fixed either to stones or other bodies. Each capsule is hermetically closed, and filled with a viscous fluid, as transparent as water, and resembling white of egg, containing a multitude of eggs (from 500 to 600 or even more). The eggs are of a globular form, furnished with a delicate chorion, a vitelline membrane, and a vitellus consisting of a fluid containing small granules. Amongst the smallest of these granules there are, as in *Buccinum*, a quantity which are oval, and refract light very strongly. We could not distinguish either a germinal vesicle or a germinal spot. After an interval of several days, a commencement of segmentation appeared in the eggs, which divided first into 2 and then into 4 spheres of segmentation. These stages passed pretty regularly. But then a great irregularity made its appearance in the segmentation: we soon saw some of the spheres divide, while the others remained intact; in others, 4 small spheres were formed between the 4 large ones; and others, again, had become divided into 12 or 18 irregular spheres. It was not rare to find eggs which had not yet undergone segmentation; some were also found in which the segmentation had progressed a little way, and in which the chorion was not yet ruptured. In our first memoir* we have given figures of these eggs, and new observations have proved their correctness. In this way we observed a number of eggs, which,

* This memoir will be found translated in the Scientific Memoirs, new series, Nat. Hist. division, p. 330, plates 10, 11 & 12.

although deposited at the same time and enclosed in the same capsule, nevertheless exhibited a great diversity in the progress of their segmentation. We did not observe any nucleus in the spheres of segmentation. Nordmann did not detect them in *Tergipes*, *Rissoa*, and *Littorina*. We have had the opportunity of observing the little clear body which Dr. Carpenter has seen quitting the egg, and which we had not previously noticed. Some days later in the development, the viscous liquid, which filled the capsules, began to grow more fluid, so that the eggs could be made to escape with the greatest ease; they were then conglomerated, and apparently formed a compact mass. On examining this more closely it was found to consist of several adherent groups, which were of different sizes, although they had no distinct forms. Under the microscope, these groups proved to consist of eggs, placed one upon the other like a mass of balls, of which the greater number were in different stages of segmentation, whilst others were not. On the sixteenth day the groups had usually become more distinct, more clearly circumscribed, and more detached from the common mass; they had acquired a cylindrical or pyriform shape. Each of these groups was formed by the union of eggs imbedded in a glutinous mass and covered by a delicate membrane, which was soon furnished with very fine cilia. The eggs themselves had undergone no subsequent segmentation, as the act of progressive segmentation had stopped as soon as the conglomeration was effected. At the side of the upper part where the embryos were attached to the common mass, we could detect an exuded, greyish, semitransparent, and finely granular mass, which had the appearance of increasing the membrane, the outer margins of which began to be furnished with some cirrhi. Whilst the membrane was increasing more and more at the point just mentioned, a similar, yellowish, exuded mass was perceived nearly at its middle; this forms the base of the future foot (Pl. XVII. fig. 3 *d*). The embryo thus formed began to move a little by the aid of its cilia and of some cirrhi; it was in fact observed to make feeble efforts in different directions, as if seeking to detach itself from the common mass; and when at length, after various futile attempts, it succeeded in doing this, it began immediately to turn upon itself. We have seen all the individuals, one after the other, detach themselves and move off in this way, until all the groups had become developed into embryos. We may believe that in this animal, as in *Buccinum*, the number of eggs which combine to form the future embryo is perfectly fortuitous; for not only can we discover no rule for this formation, but, moreover, we find that these aggregates are formed of very different numbers of eggs. Thus, in the same

capsule we have seen embryos produced by the union of 3-4 eggs, whilst 60 or more have cooperated in the formation of the majority of the individuals. The difference in the size of the individuals also depended upon the same cause. Their size varied considerably, and embryos of $\frac{1}{4}$ to 1 millim. were seen moving in the liquid then contained in the capsule. As the size of the embryos was variable, so was their number. This depended on the greater or less number of eggs which had cooperated in the formation of each individual. We have found, on the average, from 20 to 40, rarely more.

After the formation of the ciliary membrane, the organs of motion and the foot are the parts which first make their appearance. Nearly at the same time we see between the membrane and the conglomerated eggs a transparent and finely granular mass. In this are developed cells, which unite in layers with the above-mentioned membrane, and give origin to the mantle. The lowest part of the latter secretes a tolerably clear and glutinous liquid, which increases gradually, and forms the rudiments of the shell; this at its first appearance resembles a perfectly clear and gelatinous membrane, in which calcareous particles are afterwards deposited. These gradually become compact, and in this way render the subsequent investigations difficult. The rotatory organs are small at their first appearance, but their volume increases by degrees, so that they acquire more and more the form of a funnel. A multitude of cilia appear on their surface, and cirrhi make their appearance at their superior margin, and cause far more lively movements. In the foot, which is now clearly detached from the rotatory organs and has acquired a nearly square form, a mass of cells furnished with a nucleus makes its appearance. The margins are almost always inclined towards the ventral part of the animal, giving it a striking resemblance to a hollow cylinder; and as all its surface and its margins are furnished with cilia, the whole acquires the appearance of a ciliated canal. It increases rapidly in volume, and exhibits at its base the first rudiments of the auditory organs, which are formed as in *Buccinum*. At the same time we also observe the two pyriform salivary glands, which are placed close to the foot, of a yellowish colour, and filled with a quantity of round cells and pigment-grains. When the development has advanced a little further, the tentacles appear in the form of two conical eminences, at the base of which the eyes are discovered in the form of rounded vesicles, filled with a liquid as clear as water, in which some obscure pigment-grains are found. We could not discover any lens in this stage of development.

On the twenty-third day we discovered the heart. It is formed

in an analogous manner to that of *Buccinum undatum*. It is also placed on the back, a little towards the right. It contracts strongly, giving forty to fifty pulsations in a minute. It is furnished with primary muscular fibres, having the form of longitudinal tubes a little enlarged above. We found neither granules nor cells in these tubes. In this stage of development, the branchial cavity not being sufficiently deep to contain the whole heart, a considerable portion issues from it and passes the margin of the mantle. Subsequently, when the mantle becomes elongated and covers the back of the animal, its margin is directed more outwards, and removes from the body in such a way that the cavity, becoming deeper and more ample, encloses the entire heart. We have not been able to follow the rest of the circulatory system.

It is not until after these organs are formed that we observe the buccal orifice, with the pharynx and œsophagus, at the point where the rotatory organs meet on the back. The proboscis in this stage is exceedingly short, and its walls are pretty thick, so that the œsophagus is detected with difficulty. It is a cylindrical canal, which runs directly to the stomach. From the stomach, which is small and oval, issues a long and slender intestinal canal, which passes to the right, then returns to the opposite side, describing a curve, and at length terminates a little towards the right by an anus projecting into the branchial cavity. The œsophagus and also the stomach and intestines are clothed with cilia on their inner surface.

The salivary glands have also become enlarged; their cells are more approximated, and form long rows. In their broadest part a multitude of yellow pigment-grains are seen. In their more slender portion, which is turned towards the œsophagus, the excretory duct of the gland makes its appearance, and becomes elongated to meet the œsophagus. The salivary glands in the adult animal form a coherent mass, but their double excretory duct clearly indicates that this was formerly divided. On each side of the œsophagus we perceive the two cerebral ganglia, which are here distinguished from the common mass by their yellow colour. These ganglia are united to each other by a commissure, and give origin to two other commissures, which unite them with the two pedal ganglia. We have found it impossible to trace the nervous system any further, all the parts of the body having rapidly become opaque. We suppose, however, that it agrees for the most part with that of *Buccinum*. It is also about the period at which the nervous system appears, that we distinguish the first traces of the branchiæ, the siphon, and the retractor muscles of the foot. The branchiæ originate from the margin of the mantle, where they form a hollow cylin-

der, which is twisted to form loops; cilia are seen on its inner margin. It afterwards becomes a little flattened, at the same time dilating considerably. In its walls we discover longitudinal and transverse fibres, and the cilia of the middle of each loop are of extraordinary length. After the production of the branchiæ it becomes extremely difficult to investigate the formation of the other organs; on the one hand because the animal rarely elongates itself sufficiently out of its shell to allow its parts to be perceived, and, on the other, because the mantle has become a good deal thickened, and the shell has been the seat of a considerable deposit of calcareous matter. This shell has acquired the form of that of a *Nautilus*. The rotatory organs diminish considerably in size. The foot, which is lobate above, acquires more and more the form of that of the adult animal. The operculum, which serves to close the aperture of the shell, is completely developed. The heart, in this stage, is divided into two chambers. The lenses of the eyes are clearly distinguished: we have pretty frequently found a single eye which presented two projections of pigment, each provided with a lens.

The branchial cavity, of which the inner surface is clothed with cilia, has become, at this period of development, sufficiently deep to contain the heart entirely. The margin of the mantle which is furthest removed from the body of the animal is furnished with cilia, and at the bottom of the branchial cavity we for the first time discover a contractile vesicle (kidney), similar to that which exists in *Buccinum undatum*. After the lapse of eight weeks, the young animals have not yet quitted the capsules, and when one is taken out in this state, it sets itself to creep like the adult animal, with the foot, the tentacles, and the siphon extended. It is then distinguished from the adult in that the rotatory organs have not entirely disappeared, that the shell is not hard, and also by the spire, which has only one, or at most, two turns. During the ninth or tenth week the young animals quit the capsules; the rotatory organs have then disappeared, and behind the tentacles we observe a raised line, which indicates the place previously occupied by them.

The shell has become more elongated, and approaches nearer to that of the adult; it is hard, brittle, and nearly opaque, but the last turns of the spire are not yet developed. We have not referred to the way in which the development of the organs takes place, because it does not differ from that which occurs in *Buccinum undatum*. But, before concluding our memoir on the development of the *Pectinibranchiata*, we find that it is necessary to make a few observations on the memoir of Dr. Carpenter on *Purpura lapillus*, as the results which he has obtained are very different from ours.

We shall indicate the most remarkable features of this memoir in the author's own words: "The general result of my observations is, that the process has been altogether misconceived by my predecessors; that no such departure from the ordinary plan of development takes place as the fusion of a number of originally distinct ova into a single embryo; but that each embryo originates in a single ovum; that it attains to a certain grade of development by the metamorphosis of the contents of its own vitellus; but that its increase in size, and the continuance of its development, depend upon its appropriation, by a process of deglutition or swallowing, of a mass of additional or supplementary vitellus, the want or insufficiency of which occasions its partial or complete abortion. As to the immediate cause of the production of 'monstrous' embryos, therefore—a phenomenon which I have found to be far more common than MM. Koren and Danielssen supposed,—I am in accordance with my predecessors, as I attribute it, with them, to the deficiency of nutritive material. But I differ from them essentially, not merely in regard to the mode in which this nutritive material is appropriated, but also in asserting that the production of embryos from single ova, instead of being an abnormal and occasional phenomenon, is one stage in the normal process of development." The number and volume of the "egg-like bodies," which is the name given by the author to the eggs enclosed in the capsules, agree with our observations upon these eggs. But he was unable to discover the chorion, which, however, appeared to us to be very distinct, and which could sometimes be seen even after the commencement of segmentation. He did not observe either a germinal vesicle or a germinal spot in these "egg-like bodies," but on causing nearly developed eggs to escape from the ovaries, he found that they were of the same volume as the "egg-like bodies," and furnished with a germinal vesicle and germinal spot. We agree perfectly with this.

However, Dr. Carpenter states that, independently of the "egg-like bodies," he has found true eggs in each capsule. But, on asking himself what difference there was between these true eggs and the "egg-like bodies," he has only been able to find a very slight variation in their segmentation. He says that the first segments of the vitellus of these true eggs divide into several small parts, and that by this means a clearer peripheric layer is formed, which becomes enveloped in a ciliary membrane, whilst the "egg-like bodies," which are the largest, have not yet undergone segmentation. He also adds, that segmentation certainly takes place in the "egg-like bodies," but that it is not so complete, and appears to be more fractional, and intended to divide each "body" into smaller spheres. Dr. Carpenter also

asserts that from these eggs an embryo is developed, which swallows as many as it can of the "egg-like bodies," and that, being thus furnished with materials, it proceeds in its development. When the embryo cannot catch the crushed "egg-like bodies," it dies from want of nourishment.

It is easy to see that Dr. Carpenter has fallen into an error, and it is to be regretted that he should have allowed himself to be misled by a prejudice, as owing to this his observations have become obscure and confused. It is incomprehensible how he could imagine that he could distinguish the true eggs from the "egg-like bodies" only by the difference which he professes to find in their segmentation, as he ought also to know that the segmentation is sometimes very different even in animals of the same species; and he states that the segmentation in *Purpura lapillus* is very irregular. The segmentation, however, is his sole point of support, for he himself says that, with the exception of this, the eggs enclosed in the capsules (even his "egg-like bodies," as well as his true eggs) are anatomically and physiologically alike. In one word, he could find no perceptible difference.

In this we agree with Dr. Carpenter. In our memoirs we have proved that all the bodies which are enclosed in the capsules have a chorion and a vitelline membrane, and that their segmentation is not arrested by the commencement of the act of conglomeration. We have shown that all these eggs may be included in this act, but that in each capsule there are usually one or several eggs which become developed before the act of conglomeration has commenced, and that the embryos which are developed by these isolated eggs die very soon from the deficiency of material necessary for the formation of the organs. It is these embryos developed from a single egg which have led Dr. Carpenter astray: he has seen a plank of safety for his ideas of unity, and it is for this reason that he has made his creatures devour everything which might alter the law which he believes to be the foundation of all development. Thus, as soon as the embryos previously mentioned were formed, they would proceed to unite themselves with the conglomerated eggs to seek their nourishment: for this reason they would be furnished with a mouth and an œsophagus. Dr. Carpenter has given us the figure of such a mouth and œsophagus, both beset with cilia; and then, by the agency of this mouth they would attach themselves to the conglomerate. Here, however, is his greatest error; for what he gives us as the mouth and œsophagus is the foot in its different stages of development.

This occurs in the following way. The foot, in its first development, projects and slightly passes the rest of the common

mass, and acquires a rolled-up form, for its margins are curved inwards towards the plane. When we examine it superficially in this state, we find that it has some resemblance to a canal. But on observing it attentively, we soon recover the right road. In following the development of the foot, we see changes of form and structure, as well as the auditory organs at its base. If the English physiologist had done this, he would have been convinced that at first there was no mouth or œsophagus, and that therefore there could be no question of devouring the conglomerated eggs. But he would also have been able to ascertain that a group of eggs in different stages of segmentation is surrounded by a membrane, and that organization commences subsequently. It is curious, however, that Dr. Carpenter did not inquire what became of the foot of his embryos, as he is perfectly aware that this organ makes its appearance very early in the Mollusca, while he only speaks of the foot when it is completely developed, both as regards form and structure. But he observed a mouth and œsophagus, and full of the idea of the formation of these organs, he completely forgot the foot, which, however, is of considerable importance in the Mollusca..

In spite of all this, Dr. Carpenter would perhaps have avoided these errors if he had employed an intense light from above, for he would then have seen how the eggs in different states of segmentation were placed in layers, like a heap of balls, in the interior of the membrane, of which we have already spoken sufficiently (Pl. XVII. fig. 2). If he had crushed an embryo of this kind, he would also have been convinced that the entire eggs were placed one upon the other, as they occur in the conglomerate before the envelopes of the embryos are formed. With an ordinary light, he would have observed in a mass of embryos, towards the inner surface of the membrane, entire eggs, which allowed their spheres of segmentation to be seen distinctly. But this could not be the case if Dr. Carpenter was right, as he does not believe that these little creatures swallowed entire eggs; this, however, has also escaped him. When he states that he has seen how the embryos eat and swallow the vitelline mass, this is an illusion, for it sometimes happens that some vitelline segments attach themselves to the foot itself, long after the embryo has detached itself from the conglomerate; but, far from swallowing them, it endeavours with all its power to get rid of them, in which it most frequently succeeds.

Dr. Carpenter also indicates that we have deceived ourselves with regard to the development of the heart, and states that we have taken the contractile vesicle (kidney) for the heart. He asserts that the latter is not formed until after the contractile

vesicle, and that it occurs deeper in the branchial cavity. This is also an error on the part of Dr. Carpenter; it is himself, again, that is deceived; and we can affirm this without fear, as by our frequently-repeated observations we have confirmed our first impressions. And when, in conclusion, Dr. Carpenter asserts that we have also made several mistakes in the ulterior development, we are led to believe, from all that we have just explained, that Dr. Carpenter has no right to reproach us therewith. But before concluding these remarks, we should state that our observations on *Buccinum undatum* and *Purpura lapillus* no longer stand alone; for, without taking into account that M. Leuckart has made different observations equivalent to ours in the article "Zeugung," in 'Wagner's Handwörterbuch der Physiologie,' M. Lindström has shown, in the 'Öfversigt af Konglige Vetenskabs-Akademiens Förhandlingar 1855,' that the embryo of *Neritina fluminalis*, Linn., is developed in a similar manner to that of *Buccinum undatum* and *Purpura lapillus*. The egg-capsules contain 30-40 eggs, from which only a single individual is developed.

EXPLANATION OF PLATES XVI. AND XVII.

[The figures here given are only a selection from those of the authors.]

PLATE XVI. Magnified about 150 diameters.

- Fig. 1. Grouped eggs and newly-formed embryos of *Buccinum undatum*, the greater part of which are already furnished with rotatory organs, foot, auditory organs, salivary glands, and heart: *a*, the mass exuded from the eggs; *b*, the softened chorion; *c* & *d*, membrane surrounding the eggs; *e*, an embryo formed by a single egg.
- Fig. 2. An embryo seen from the ventral surface: *a*, membranous shell; *b*, mantle; *c*, eggs; *d*, heart; *e*, rotatory organs; *f*, foot; *g*, auditory organs; *h*, salivary glands; *i*, pharynx; *k*, oesophagus; *l*, stomach; *m*, branchiae.
- Fig. 3. An embryo seen from the side: *a*, shell; *b*, eggs; *c*, foot; *d*, rotatory organs; *e*, tentacles with eyes; *f*, heart; *g*, the large cerebral ganglia; *h*, the small cerebral ganglia; *i*, commissures of the pedal ganglia; *k*, auditory organs; *l*, commissures of the branchial ganglion; *m*, branchial ganglion; *n*, nerves of the intestines; *o*, pedal ganglia; *p*, salivary gland; *q*, branchia; *r*, retractor muscle; *s*, stomach; *t*, intestine; *u*, liver, and above this the contractile vessel (kidney).
- Fig. 4. An embryo seen from the side: *a*, shell; *b*, siphon; *c*, foot; *d*, operculum; *e*, tentacles.

PLATE XVII.

- Fig. 1. Nervous system of an embryo, somewhat compressed, magnified about 200 diameters: *a*, the two large cerebral ganglia; *b*, the two small cerebral ganglia; *c*, the two large pedal ganglia;

d, branchial ganglion; *e*, intestinal ganglion; *f*, the two small pedal ganglia; *g*, commissures of the small cerebral ganglia to the pedal ganglia; *h*, commissures of the large cerebral ganglia to the branchial ganglion; *i*, commissures of the large pedal ganglia to the branchial ganglion; *k*, auditory nerves; *l*, optic nerves; *m*, nerves (commissures) of the large pedal ganglia to the small pedal ganglia; *n*, nerves which arise from the large pedal ganglia, and ramify; *o*, nerves of the small pedal ganglia, which also ramify; *p*, nerve of the intestinal ganglion; *q*, nerve of the heart; *r*, nerves of the intestines.

Magnified about 150 diameters.

- Fig. 2.* An embryo of *Purpura lapillus* recently detached from the common mass of eggs: *a*, conglomerated eggs; *b*, membrane furnished with cilia; *c*, the commencement of the rotatory organs, furnished with cirrhi.
- Fig. 3.* An embryo seen from the back: *a*, *b*, *c*, as in the preceding figure; *d*, the foot further developed and furnished with cilia.
- Fig. 4.* An embryo seen from the back: *a*, *c* & *d*, as in the preceding; *b*, the shell; *e*, salivary glands; *f*, tentacles; *g*, eyes; *h*, heart; *i*, mantle.

The following Figures are magnified about 200 diameters.

- Fig. 5.* An egg of *Buccinum undatum* in which the vitellus has divided into numerous spheres of segmentation: *a*, membrane; *b*, spheres of segmentation.
- Fig. 6.* An embryo formed by a single egg, of which the vitellus has divided into two spheres of segmentation: *a*, exuded mass; *b*, two spheres of segmentation.
- Fig. 7.* An embryo also formed by a single egg, in which some organs are already formed: *a*, membranous shell; *b*, mantle; *c*, two spheres of segmentation; *d*, rotatory organs; *e*, foot.
- Fig. 8.* The embryo of one egg, seen from the ventral surface, and in the centre of which four spheres of segmentation are seen: *a*, membranous shell; *b*, mantle; *c*, four spheres of segmentation; *d*, rotatory organ; *e*, foot, with auditory organs.
- Fig. 9.* An embryo with eight equal spheres of segmentation: *a*, membrane; *b*, spheres of segmentation.
- Fig. 10.* The same embryo a little more advanced in development.
- Figs. 11, 12.* The same embryo, more advanced: *a*, shell; *b*, mantle; *c*, spheres of segmentation; *d*, rotatory organs; *e*, foot.
- Fig. 13.* An embryo seen from the ventral surface: *a*, membranous shell; *b*, mantle; *c*, spheres of segmentation; *d*, rotatory organs; *e*, salivary glands; *f*, œsophagus; *g*, pharynx.
- Fig. 14.* An embryo seen from the back: *a*, *b*, as in fig. 13; *c*, rotatory organs; *d*, foot; *e*, salivary glands; *f*, stomach; *g*, pharynx.
- Fig. 15.* An embryo formed of three eggs, seen from the back: *a*, *b*, as in fig. 13; *c*, vitelline mass; *d*, *e*, as in fig. 13; *f*, foot; *g*, pharynx.
- Fig. 16.* An embryo seen from the back: *a—f*, as in preceding; *g*, stomach; *h*, œsophagus.
- Fig. 17.* An embryo formed by three eggs: *a—g*, as in fig. 16; *h*, pharynx; *i*, heart.

XXXIV.—List of Coleoptera received from Old Calabar, on the West Coast of Africa. By ANDREW MURRAY, Edinburgh.

[Continued from page 326.]

Addenda to Nycteis and Belonognatha.

SINCE my remarks on these genera were published (in the April number of the Annals) I have received another species, which confirms the view I there threw out that they should be conjoined. The species now received has the elongate labrum canaliculated at the apex of *Belonognatha*, and also has the mandibles longer and sharper than in *Nycteis*, although not quite so prominent as in the other species of *Belonognatha*, while its form is less tumid, and possesses the other characters of *Nycteis*, except that the apex of the elytra is rounded at its emargination instead of being toothed. This combination of characters renders it, I think, impossible to keep the two genera separate; or, at all events, if we do so, we must alter the characters,—we must retrench the elongate mandibles, as well as the form of the labrum and of the apex of the elytra, from the characters. There is, indeed, a trivial character which separates the species (after abstraction of the above characters) into two groups, nearly equivalent to *Nycteis* and *Belonognatha*, viz. that under a powerful lens we see that one group has the elytra finely aciculated or reticulated, something in the same way as the *Calathi*, while the other has the elytra polished and shining, without this aciculation, and generally appearing metallic when looked at from in front, and dark-coloured when looked at from behind. My arrangement of this genus would therefore stand thus: viz.—

NYCTEIS.

Essential characters the same as in *Coptodera*, but without the middle tooth to the mentum.

Subgenus 1. (*Nycteis* proper).

Elytra finely aciculated or reticulate, and body not very convex. Under this head fall—

Coptodera flexuosa, Schmidt-Goebel, and probably all the other Eastern *Coptodera* described by him. *Coptodera bicincta*, Hope. Probably all the Caffrarian species described by Boheman, Chaudoir's *C. figurata*, and possibly Klug's *Beleopterius signatus*, besides my species *N. Championi*, and the new species (*N. intermedia*), the description of which follows.

Subgenus 2. (*Belonognatha*).

Elytra polished and shining, without aciculation or reticulation. Body convex, and mandibles usually prominent and acute.

This subgenus contains the species I have already described under the names of *Belonognatha rugiceps*, *obesa*, and *quadri-notata*, besides, doubtless, Chaudoir's species, *B. pustulata*, and possibly Klug's *Beleopterus cyanipennis*.

The characters of the new species lately received are as follow :

2. *N. intermedia*, mihi.

Valde affinis *N. Championi*, sed parum minor, labro magis elongato et ad apicem canaliculato; mandibulis acutioribus; thorace minus transverso et postice angustiore; elytris apice emarginatis sed non dentatis, angulis posterioribus rotundatis, cum maculis anticis grandioribus et maculis posticis minus continuis.

Long. 3 lin., lat. $1\frac{1}{2}$ lin.

Has very much the appearance of *N. Championi*, but, on comparison, is readily distinguished by the characters mentioned in the above diagnosis. The insect is smaller, and the coloration is the same, only a little darker. The labrum is longer, and narrowed towards the point, where it is canaliculated. The mandibles are more slender, more acute, less rounded on the exterior, and narrower at the base. The head is narrower, and is marked by a number of minute longitudinal wrinkles. The thorax is not so transverse and is narrower behind, and the reflexed margin is not quite so broad. The elytra are rounded at the posterior angles instead of being toothed, and the testaceous markings on them are slightly different; the anterior marking is confined to the same striæ, but is rather larger from the colour running further on some of them; it runs up on the second and third striæ nearly as far as on the fourth, only sloping very slightly towards the suture, while in *N. Championi* the fourth goes a good deal beyond the third. The posterior markings are the same as in *N. Championi*, but are narrower, and consequently appear almost interrupted where they advance at the third stria and retreat at the fifth. They both have the elytra very finely transversely aciculated, but the aciculations are finer on *intermedia* than *Championi*, the power of lens which shows them in the latter scarcely showing them in the former. In other respects they correspond.

There is yet another species which I have no doubt belongs to this section, and which I would name *quadrimaculata*; but, as

yet, I have only received a broken specimen, wanting both head and thorax, and am therefore unable to describe it. It has two large yellow patches on each elytron, the basal nearly round, and the apical transversely oblong, both with very slight traces of jagged edges.

Ozenidæ.

GONIOTROPIS, Gray.

The species which follows certainly belongs to this genus, although it differs in one or two unessential points from the characters which have been given as generic by Gray. That author gives the mandibles as pluridentate on the inner side, and the anterior thighs as dentate on the under side, neither of which is the case in my *G. Wylieri*; but, as in all other respects it agrees with the diagnosis of *Goniotropis**, I do not propose to make a new genus for it on account of them, but merely withdraw the above specialties from the characters of the genus, and thus widen it to receive the following species.

1. *G. Wylieri*, mihi.

Castanea, nitida, lævis; capite antice et postice levissime punctato, vertice elevato, impunctato; mandibulis elongatis, robustis, non dentatis; labro integro; thorace marginato, angulis posticis fere rectis sine emarginatione; elytris, capite et thorace paulo longioribus, parallelis, cum carina marginali interrupta et fortius plicata versus apicem; femoribus non dentatis, tibiis anterioribus arcuatis, intus fortiter emarginatis. Long. 5 lin., lat. $1\frac{1}{2}$ lin.

Colour uniform chestnut, shining, smooth; head faintly, aciculary, irregularly punctate in front, and still more sparingly behind, with the vertex raised and impunctate; clypeus solid and smooth, outline in front very slightly concave; labrum transverse, and almost as broad in front as behind, entire†, a row of punctures, from which hairs proceed, extending along

* The reader will find the generic as well as the specific characters noticed in the following description, so that he can satisfy himself that I have not overlooked any of importance.

† The labrum certainly cannot be called emarginate, although perhaps the anterior angles may be said to be very slightly more advanced than the centre of the anterior margin; still the line of margin is very nearly straight. A similar slight inequality would perhaps explain how the figure published by Gray of his *G. Brasiliensis* shows an emarginate labrum, while he makes no mention of its emargination in the text, and would confirm the view taken by Lacordaire, that the genus *Ictinus* of Castelnau (which has the

the front; mentum with a tooth in the middle; ligula short, narrow, truncate; paraglossæ broad, truncate, adhering to the ligula throughout their length; labial palpi short and robust, last joint somewhat securiform; maxillary palpi longer, last joint subcylindric, depressed, and truncate; mandibles robust, elongate, and rounded in front, a few scattered hairs along their exterior, without teeth along the interior margin; antennæ about as long as the head and thorax, flattened, gradually increasing in size to the end, the last joint more than twice as long as the preceding; thorax as long as broad, cordiform, surrounded with a border along the sides, flat anteriorly, but broader and reflexed behind, ending in a fovea near the basal angles, which are nearly right-angled; no emargination in front of them; a dorsal longitudinal line not reaching quite to the front, a semi-circular line in front, and a transverse line a little before the base, which is truncate and almost straight; elytra elongate and nearly parallel, with a reflexed margin or raised keel running along the exterior sides to near the extremity, where it terminates, and then another keel commences a little within it, with a more prominent fold, which continues for a very short space, and is then replaced by an ordinary raised margin, which disappears near the apex; an inner raised callosity or rounded ridge commences near the above fold, and continues parallel to it and the raised margin till near the apex, where it joins it, and both cease. Under a powerful lens, the elytra are seen to be sparingly and faintly punctate; one or two rows of deeper, distant punctures (eight or nine in number) occur on the disk, and a series of foveæ runs along the marginal depressed space next the raised margin. Under side and legs a little paler than upper side, shining, bearing throughout a few scattered punctures, and somewhat pubescent, more particularly the tibiæ and tarsi. Anterior legs with thighs without teeth, but with a hollow space on the under side; tibiæ strongly arched and very deeply emarginate on the inside, the margin of the excised space very closely fringed with pubescence, and the tooth behind the emargination slightly incurved, with a few hairs projecting; intermediate and posterior legs simple; coxæ of the former adjoining each other; anterior pair more separated, and posterior pair widest apart; trochanters of the latter large and broad; tarsi of all the legs short and robust; claws simple.

I have named the above species of this rare and interesting genus after Mr. Wylie, to whom I am indebted for this as well as many other valuable species discovered and sent home by him.

labrum entire) is identical with the *Goniotropis* of Gray, notwithstanding this apparent though trifling discordance in their characters.

Morionidæ.

MORIO, Latr.

1. *M. Guineensis*, Imhoff, Verh. d. nat. Gesells. in Basel, vi. 166.

M. Senegalensis, Dej. Cat.

Niger, nitidus, depressus; prothorace lato, subcordato, angulis anticis prominulis, posticis rectis, medio et utrinque intra basin sat profunde canaliculato; elytris prothoracis fere latitudinis quam latis non duplo longioribus, parallelis, evidenter striatis, interstitiis subconvexis lævibus; pedibus ferrugineofuscis.

Long. $8\frac{1}{2}$ –6 lin., lat. 3–2 lin.

This species varies considerably in size, so much so as almost to lead one to suppose that there are at least two species con-founded in it, particularly as the larger individuals seem to the eye broader in proportion than the smaller ones. Careful examination and measurement, however, show that this is a mere ocular deception, the relative proportions being the same. It approaches very nearly to *anthracinus*, Bohem., and *parallelus*, Klug. The relative proportions of this species are as follow:—Thorax broader than long. Length of elytra rather more than twice the length of thorax, and about $1\frac{1}{4}$ or $1\frac{3}{4}$ times the breadth of the elytra. In my specimens from Senegal the elytra are rather more elongate, being nearly twice as long as they are broad; but as I can find no other difference, I have not considered it a new species.

PLATYNODES, Westw.

1. *P. Westermanni*, Westw. Trans. Ent. Soc. 1845, p. 278. vol. iv. pl. 21. fig. A. Pl. XIII. fig. 7.

Niger, subnitidus; capite magis nitido, antennarum articulis apicalibus brunneis, superficie corporis lævi; singulo elytrorum striis 7 simplicibus et gracillimis instructo, spatio inter striam 6 et 7 ad latera in carinam elevato, spatioque intra marginem lateralem punctis parvis rotundatis impresso.

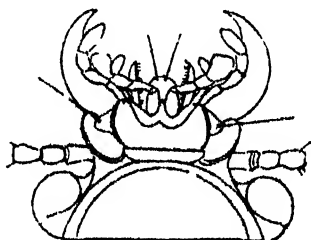
Long. $18\frac{1}{2}$ lin., lat. $4\frac{1}{2}$ lin.

The insect I have from Old Calabar seems to be the same species that has been already described and figured by Mr. Westwood (*loc. cit.*). I have only received a single specimen, and I find one or two trifling discrepancies between it and the figure given by Mr. Westwood, as well as a typical specimen of *Wester-*

manni in the magnificent collection of the Count Mnizasek in Paris. These are the following:—The antennæ in my specimen are not quite so much thickened; the anterior tarsi are less dilated; the scutellum is smaller, and the posterior angles of the thorax are less salient. Some of these may be mere sexual distinctions, and the remainder possibly accidental variations; at all events, none of them, according to my views, suffice to constitute a new species.

Mr. Westwood, in his generic description of this insect, says that the abdomen has only four segments. I would express this differently. It may only have four separable segments, but the segments are in reality five, the first two segments being soldered together, so that their line of separation is indistinct in the middle; but it is quite distinct and well marked at the sides. This appears to be the normal state of matters in the *Morionide* and *Scaritide*. There is also a side-piece before the first segment, which may be viewed as part of another segment.

STEREOSTOMA, mihi (στερεὸς and στόμα).



Caput parvum, parum convexum, quadratum, pone oculos sine tumore et sine collo retractato. Labrum breve, transversum. Mandibulæ robustæ, subtus concavæ et excavatæ, supra rotundatæ, apice acutæ, intus sine dente. Maxillæ parvæ. Palpi breves et robusti: articulus ultimus palporum externorum ovato-cylindricus et truncatus; palporum labialium grandis, crassus et late securiformis. Mentum breve, transversum, profunde excavatum et fortiter emarginatum, cum dente medio simplici et malis acutis, lateribus rotundatis, extus caput valde alveato. Ligula curta et angusta, truncata. Paraglossæ nullæ. Antennæ breves, moniliformes, articulis apicalibus velutinis, compressis et dilatatis versus apicem, cum spatio sat lato lævi et nitido singulis relicto et supra et subtus. Prothorax subquadratus, parum subcordatus, capite multo latior, postice quam antice parum angustior et longitudinaliter bifoveolatus; basi medio leviter transverse productus. Pro-

sternum sat latum et prominens retro paulo projiciens. Scutellum parvum. Elytra elongata, parallela, striata, sat convexa, apice abrupte declivia et leviter emarginata haud truncata. Pedes mediocres. Tibiæ anticæ dilatatæ, subtus excavatæ, intus emarginata. Tarsi breves, transversi, fere moniliformes, antici breviores; in fœmina, et supra et subtus nitidi et politi, sine setis vel squamis, ciliis ad marginem anteriorem singulorum adstrictis exceptis; in mari, antici setis longis instructi, ceteris ut in fœmina*; unguiculi simplices. Corpus elongatum, parallelum et parum convexum. Abdomen segmentis quinque, quorum primum et secundum conglutinata sunt.

1. *St. Whitei*, mihi. Pl. XIII. fig. 6.

Nigrum, politum, nitidum; capite foveis quatuor fronte impressis, quadrangulariter positis, et lineis impunctatis tribus lateribus junctis; thorace elytris angustiore, postice longitudinaliter bifoveolato et linea dorsali, postice profundiore impresso, angulis posterioribus rectis, non productis; elytris striatis, striis leviter punctatis, interstitiis impunctatis planis.

Long. 6 lin., lat. $2\frac{1}{4}$ lin.

Black, polished and shining. Antennæ short, robust, compressed and dilated towards the apex; first three joints smooth, with one or two large punctures on the first and second, the rest dull pubescent, with a broad, flat, polished line running up the middle of the compressed sides, both above and below, till near the end of the last joint; some of the joints with one or two punctures on the polished space. Head smooth and polished. Mandibles above having some resemblance to the beak of a hawk, and hollowed out below. Clypeus marked off from the head by a straight impunctate line, which ends at each side in a deep puncture or fovea, from which a shorter and fainter line runs obliquely outwards and forwards to the exterior base of the mandibles; from each of these two foveæ an impunctate line runs straight backwards and very slightly outwards, ending in another deep elongate puncture or fovea on each side of the front between the eyes, so that the marking on the front consists of three lines forming three sides of a square, each corner being marked by a deep puncture, the fourth or posterior side of the square being open or without any line; besides these punctures, there are two others on the inner edge of each eye, one at the middle, which partly interrupts a longitudinal groove which

* I make this statement only from the examination of a male specimen of *St. Whitei* and a female of *St. solidum*, these being all which have come into my hands. But I have no doubt it is correct, as I find a similar difference in structure in the other *Maronidae*.

runs along the side of the eye and head, and the other behind, where the groove terminates at the posterior inner angle of the eye. There is no tumour behind the eye, but its posterior margin is slightly encroached on by the black chitinous substance of the head, but without the contour of the eye being altered. The head behind is smooth and rather convex. Thorax subquadrate, with a slight tendency to be cordiform, impunctate, shining, much wider than the head, narrower than the elytra, emarginate, becoming narrower behind; anterior angles projecting and rounded; sides gently rounded and margined, the margins extending round the anterior angles, and then gradually becoming wider and disappearing before the middle, the base not margined; a channel runs along the sides inside the margin, in which six or eight large impressions are placed widely apart; the base is transversely produced in the middle, as in *Lebia*; at the sides it is straight, and the posterior angles are nearly right-angled. Dorsal stria faint and interrupted till towards the base, where it becomes deeply impressed; a very deep fovea on each side of it nearer the sides, with a longitudinal impunctate groove in the bottom of the fovea. Prosternum with a faint longitudinal depression, impunctate. Scutellum small and impunctate. Elytra elongate, parallel, margined, punctate-striate, the striae deepest towards the apex and margin, the punctures in the striae small, and not very close to each other; the striae are seven in number, and there is no abbreviated stria near the scutellum. Interstices flat and impunctate, except the marginal interstice, which is impressed with a row of large, round, circular depressions, with a point in the centre. The elytra are somewhat flat on the top, except near the sides and apex, where they suddenly and rapidly descend; the apex is not truncate, but sinuate; the first and second striae join together at the apex, and the third and fifth or sixth enclose those between them; under side polished, shining, impunctate, except a row of four or five large punctures on each segment of the abdomen. There are five segments, besides a side-piece in front of them, but the first and second are soldered together, and the separation between them is not to be seen except at the sides, so that on a cursory view there only appear to be four segments. Tibiae with spinous hairs on the exterior, strongest on the anterior pair; posterior and middle tarsi longer than anterior.

I have dedicated this species to my friend Mr. Adam White, of the British Museum, to whose extensive information and kind assistance I have been on many occasions much indebted.

2. *St. solidum*, mihi.

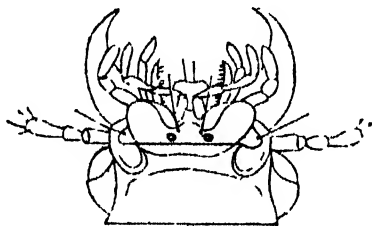
Præcedenti valde affinis sed grandior, latior et convexior; tho-

race elytris vix angustiore, angulis posticis productis; elytris striato-punctatis, interstitiis impunctatis convexis.

Long. $7\frac{1}{2}$ lin., lat. 3 lin.

Exceedingly close to the preceding species, but larger, broader, and more convex; the posterior margin of the eye is more encroached on by the chitinous substance of the head than in the last; the polished space in the middle of the flat sides of the antennæ is rather broader, and is entirely smooth and without punctures. Thorax more convex, broader, and less narrowed behind than in the preceding species, scarcely narrower than the elytra, bisinuate in front, and with the posterior angles projecting backwards. There is a greater number of impressions in the channel along the margin than in the last species. Prosternum with several deep punctures arranged somewhat in a longitudinal double row along its projecting part. Elytra punctate-striate; interstices impunctate and convex, the punctures and impressions on the sides deeper and more distinct than in the last species; the stria next to the suture also is nearer it, which makes the rest of the interstices look wider; the part of the elytra beside the suture is more depressed than the rest. In other respects the two species agree.

BUDERES, mihi (*Βούς* and *δέρη*).



Caput parvum, quadratum, parum convexum, pone oculos sine tumore, sed parte posteriore oculorum tegumento tecta, foveis duabus sinuatis fronte longitudinaliter valde impressis. Labrum transversum, antice quam postice latius, angulis anticis projicientibus margineque antico emarginato et ciliato. Mandibulæ robustæ, extus rotundatæ supra carinatæ, apice acutæ intus sine dente. Maxillæ acutæ. Palpi breves et mediocriter robusti; articulus ultimus palporum externorum longus et cylindricus, articulus penultimus triangularis basi pedunculatus; articulus ultimus palporum labialium elongato-ovatus. Mentum latum, leviter excavatum et profunde emarginatum, cum

dente medio bifido et malis rotundatis. Ligula curta, truncata, leviter emarginata, antice quam postice latior, carinata. Paraglossæ nullæ. Antennæ breves moniliformes, articulis apicalibus velutinis compressis et dilatatis, cum spatio sat lato lævi et nitido singulis relicto et supra et subtus. Prothorax subquadratus, anguste marginatus, capite multo latior, antice quam postice parum angustior, linea tenui longitudinali media et lineis duabus posticis longitudinaliter impressus, angulis anticis parum acutis, posticis fere rectis. Prosternum sat prominens et paulo projiciens. Scutellum mediocres. Elytra prothoracis fere latitudine, brevia, sat convexa et sat fortiter marginata, striata, apice emarginata haud truncata. Pedes mediocres. Tibiæ anticæ dilatatæ, intus emarginatæ, subtus excavatæ. Tarsi breves transversi et moniliformes, antici breviores; in fœmina et supra et subtus nitidi et politi, sine setis vel squamis, ciliis ad marginem anteriorem singulorum adstrictis exceptis; in mari antici squamis setisque instructi, ceteris ut in fœmina. Unguiculi simplices. Corpus haud elongatum, parum convexum. Abdomen segmentis quinque, quorum primum et secundum conglutinata sunt.

This genus is nearly allied to the preceding, but it differs in its shorter, more compact, and convex shape, somewhat different form of the thorax, and in its mentum having a bifid tooth in the middle instead of a single tooth; in the last joint of the labial palpi being slender elongate-ovate instead of large, swollen and securiform, and in the underside of the anterior tarsi in the male being furnished with closely applied squamulæ instead of long bristles.

1. *B. Oberti*, mihi.

Nigrum, politum, nitidum; capite foveis duabus sinuatis fronte longitudinaliter impresso, singulis lineis duabus antice conniventibus impressis; antennis brunneis; thorace impunctato, lineis duabus posticis angustis impresso; elytris septem striis impunctatis impressis, postice profundioribus, interstitiis convexis; pedibus brunneis.

Long. $5\frac{1}{2}$ lin., lat. $2\frac{1}{2}$ lin.



Black, polished, shining. Antennæ ferruginous-brown, short, robust, compressed and dilated towards the apex; the first three and greater part of the fourth joints polished, the rest dull pubescent, with a flat, polished line running up the middle of

the compressed sides, both above and below, nearly to the end of the last joint. Head smooth and polished. Labrum with a row of large punctures (from which spring hairs) in front. Mandibles with a bisinuated keel, broadest in the middle, running along the upper side. A narrow marginal ridge runs along each side of the head until it reaches behind the eye. The two frontal impressions are sinuate, each composed of two deep lines which meet in front and extend in a sinuate manner backwards, diverging gradually from each other; they are joined in front by a straight transverse line: all these lines are impunctate. Head behind smooth and convex. The thorax is subquadrate, and has somewhat the form (in miniature) of that of some species of *Pasimachus* (e. g. *P. sublaevis*, Beauv.); it is smooth, shining, and impunctate; the dorsal median line is faint, and reaches neither to the front nor base; the two foveated lines at the base are placed nearly midway between the median line and the margin, but rather nearer the middle; they are long, deep, well defined and narrow, and at their base turn off towards the sides at a right angle, forming a narrow ridge on the exterior portion of the base of the thorax, which is wanting in the centre, and which continues along the lateral margins round to and past the anterior angles, and a considerable distance along the anterior margin, but fades away before reaching its middle. A deep channel thus runs along parallel and close to the margins of the thorax. The prosternum is rather broad, and slightly produced and expanded behind. Near the termination of the expansion there is a sort of double depression, which leaves a narrow raised margin. Scutellum impunctate, scarcely reaching to the part of the elytra where the striae commence. Elytra smooth, shining, and impunctate, with seven deep impunctate striae besides the marginal stria; the striae become deeper towards the apex; there is no abbreviated sutural stria. The first two striae run alongside up to the apex; the third and fourth join together a short distance from the apex, and their united line goes on for a short distance; the fifth and sixth do the same; the seventh runs the whole length, becoming wider towards the apex, where one or two circular punctures or foveae occur. The marginal stria has a number of these impressed on it; it runs up to the apex, where it widens much, and is divided by a raised line, which proceeds from the emargination near the apex. The marginal ridge of the elytra is rather broad and prominent. A faint stria runs along the under margin of the reflexed edge of the elytra; the interstices between the striae are convex, but more so on the sides and towards the apex than at the middle and base. The under side is smooth, polished, and impunctate, except two minute punctures, one on each side of

the middle of each segment of the abdomen. The segments also show depressions along the sides. The legs are ferruginous-brown.

I have named this interesting species in honour of my esteemed correspondent, M. Obert, of the corps of Cadets, Paulow, St. Petersburg.

OCHYRODUS, Schiödte.

Prof. Lacordaire disallows this genus, not considering it sufficiently distinct from *Scarites*, the only differential characters given being, that the second joint of the labial palpi is enlarged on the inner side and prolonged at its anterior internal angle, that the mandibles are toothed in their whole length, and that the last joint of the tarsi is of the length of the preceding joints united. The last of these characters is incorrect; the last joint, although long, not being so long as represented, and scarcely longer than that in other species of *Scarites*. The second character is wholly unimportant, even although it were not found in other species of *Scarites* (which it is). But the first is of more value: the first joint of the labial palpi is long, broad and flat, prolonged inwards at its anterior angle, and strongly ciliated on its inner side, so that it seems to be almost a second maxilla, and no doubt serves the purpose of such. This seems a sufficiently important character to justify us in retaining the genus as distinct, the rather that the *facies* of the insect is somewhat different from that of *Scarites*. Its thorax is narrowed in front more than in any other species, and its form is deeper.

1. *O. gigas*, Schiödte in Kroyer Naturhist. Tidsk. ser. 2. ii. p. 350. tab. 4.

Grandis, niger, nitidus; mandibulis fortiter dentatis, supra bicarinatis, capite longioribus; capite foveis duabus elongatis postice convergentibus, fronte impresso, postice lateribus sparsim punctato, vertice impunctato; thorace antice angustato, marginato, linea punctorum ad marginem et pluribus ad angulos anteriores impresso, margine exciso ante medium; elytris parallelis, substriatis, interstitio secundo, quarto et sexto sparsim et irregulariter, leviter sed distincte punctatis; crinibus ferrugineis sat longis ex punctis, tam capite quam thorace et elytris orientibus; subtus minus nitidus; tarsis robustis, articulo ultimo elongato.

Long. 24 lin., lat. 7 lin.

SCARITES, Fabr.

1st Division of Dej. *Intermediate tibiæ with two prominent external spines.*

1. *Scarites Hercules*, mihi. Pl. XII. fig. 4.

Niger, subdepressus; tibiis anticis tridentatis, postice haud denticulatis; mandibulis magnis, fere usque ad apicem dentatis, thorace longioribus; mento valde concavo, cum duabus foveis profundis et rotundis in medio ad basin; thorace transverso, duplo latiore quam longiore; elytris elongatis, thorace triplo longioribus, subquadratis, subparallelis, marginatis, pone medium paulo dilatatis, carina basali, dente humerali, et carina longitudinali ex humeris orienti paratis, subtiliter punctato-striatis, ad basin et lateribus usque ad apicem papillosis.

Long. 23-20 lin., lat. $6\frac{1}{2}$ - $5\frac{1}{2}$ lin.

A fine large species. Black and shining. The head and mandibles broad and massive, but varying in size. Mandibles longer than the thorax, bicarinated on the exterior side, declive at the tip, dentated interiorly almost to the tip, the teeth consisting of one or two larger ones at the base, and three or four smaller ones before them. Antennæ black or piccous, the basal joints rounded and shining, the rest flattened and pubescent, with a broad polished line running along them both above and below. Head smooth, with two deep longitudinal foveæ turning away in front nearly at right angles towards the antennæ; wrinkles more or less distinct radiate from these depressions; an irregular depression lies in the margin just behind the labrum, which, as in the other species of this genus, is small and transverse, rounded on the sides, and toothed in the centre; a very large and prominent projection behind the eye encroaches on the posterior half of it; a few scattered, very faint punctures and wrinkles may be seen about the vertex. Thorax transverse, twice as broad as long (taking the measurement of the breadth at the widest, and of the length at the middle), sloping gently from the anterior angles to the fold or tooth on the margin, and rapidly from thence to the base; dorsal line distinct to the anterior marginal line, which is faint; space along that line marked with short, faint, longitudinal lines or folds. Scutellum situated on the peduncle, basal portion somewhat rugose; preaputellar space coarsely rugose, except in front and on the sides, where it is smooth. Elytra elongate, a little more than three times the length of the thorax, subparallel and subquadrate, margined, the margin dilated a little behind the middle, faintly punctate-striate, the base and margins covered with small papillæ; three

impressions on the third stria, the first about a third from the base, the next rather more than a third from the apex, and the last between this and the apex, but furthest from the latter. A ridge runs from the base to the shoulder, and terminates in a prominent tooth; it is not greatly curved, and just within the tooth a ridge commences, running nearly parallel to the sides of the elytra, but converging a little; it has a scarcely perceptible sinuation near the base, and disappears before it reaches the apex. Traces of a row of punctures inside this ridge are visible near the base, and the stria next to it is the deepest. Under side shining; the back part of the head below is irregularly and pretty closely punctate. Mentum very concave; middle part with a deep rounded hole (about the size of a pin's head) on each side of the middle ridge, which forms the apex of the middle tooth; a double line (connected here and there) runs up the middle of the back part of the head, terminating in front in two punctures; one puncture, or two combined into one, lies immediately behind the posterior angles of the mentum; projection of prosternum smooth and rounded, with traces of three faint lines behind, the two marginal ones diverging outwards. In one specimen which I possess, this projection is slightly depressed in the middle. One distinct puncture on the posterior coxæ, also two punctures on each of the segments of the abdomen, one on each side of the middle, besides shallow depressions along the sides, and transverse wrinkles more or less distinct; the last segment has also another puncture on the margin, a little exterior to the other two. Anterior tibiæ tridentate, without denticulations behind; under side of the palmate portion with a number of papillæ or small spines; middle tibiæ with a strong spine projecting externally near the apex, a smaller one behind it, and a row of minute papillæ or spines further back.

2. *S. Ajax*, mihi. Pl. XII. fig. 5.

Præcedenti affinis, sed minor; niger, subdepressus; tibiis anticis tridentatis; mandibulis bidentatis, thorace brevioribus; thorace haud duplo latiore quam longiore; elytris elongatis, thorace fere triplo longioribus, subquadratis, subparallelis, marginatis, pone medium paulo dilatatis, subtiliter punctato-striatis, carina basali, dente humerali, et carina longitudinali ex humeris orienti paratis, ad basin et lateribus usque ad apicem papillosis.

Long. 18 lin., lat. $5\frac{1}{2}$ lin.

Allied to the preceding, but smaller, and at once distinguishable by its shorter mandibles, which are not so long as the thorax, and have only two teeth instead of six or seven; by the

thorax not being twice as broad as long, and the exterior margins not sloping so much inwards towards the tooth on the sides of the thorax, so that the thorax looks rather more quadrate. The ridge running down the elytra from the shoulder has less appearance of sinuation, though it is so slight in either, that it scarcely deserves to be spoken of. The impressions on the third stria seem also different, the two posterior impressions being placed further back; but, as they vary in different examples, and even on different elytra of the same individual, no value can be placed on this character. In other respects the description of *S. Hercules* will apply also to this. It is still more nearly allied to *S. Feisthamelii*, Laferté. It is, however, larger and more massive, the striae on the elytra seem more defined and less punctate, and the thorax is comparatively narrower, particularly in front, the length of both being nearly the same (3 lin.), while the greatest breadth in front of *S. Feisthamelii* is $4\frac{1}{4}$ lin., and in *Ajax* $5\frac{1}{4}$ lin.

It is possible that a larger series of specimens may show these two to be the same species; but, until we obtain this, I have preferred to keep them distinct.

3. *S. Patroclus*, mihi.

Niger, nitidus, elongatus, subcylindricus; tibiis anticis tridentatis, postice quadridenticulatis, subtus transverse corrugatis; mandibulis thorace brevioribus, oblique corrugatis; mento corrugato, carina media parato; capite antice longitudinaliter corrugato, fronte bifoveolato; thorace parum convexo, sesquilatior quam longiore, lateribus antice fere parallelis, ad angulos posticos leviter papilloso; elytris parallelis, parum convexis, anguste marginatis, punctato-striatis, carina basali, vix dente humerali paratis, et sine carina longitudinali, ad basin et lateribus usque ad apicem papillosis; subtus prosterno truncato.

Long. 15 lin., lat. $4\frac{1}{2}$ lin.

Black, shining, elongate, subcylindric. Mandibles not longer than the thorax; left mandible with one large subquadrate tooth, right mandible with two; the upper side with two ridges or keels on the exterior side, and the whole furrowed with strong, oblique corrugations curving inwards. Labrum longitudinally corrugated, with three projections or teeth, and a large, deep puncture in the middle of the central projection. Head corrugated longitudinally in front, and with two longitudinal frontal foveae, turning off transversely towards the exterior anterior angle; a ridge or projection in front of the eye, and a very slight swelling behind the eye encroaching on part of it. Mentum

corrugated and papillose, a central keel with a longitudinal fovea on each side of it running up the middle of the median tooth. Antennæ as in the other species, but rather more slender in proportion, fuscous. Thorax subquadrate; sides subparallel, only sloping very slightly in, till they reach the marginal tooth (which is scarcely one-fourth from the base), when they turn in directly to the base. In the posterior angles there are a number of faint papillæ; there is a margin all round the thorax continued in front, where it is widest; the dorsal line, which is distinct, reaches this margin, but does not at all enter on it. Scutellum on peduncle, smooth; prescutellar space rugose in the middle, smooth all round. Elytra nearly parallel, subconvex, punctate-striate, interstices impunctate; a narrow margin surrounds the elytra, next to which, both at the base and all round, there is a space covered by papillæ; a row of impressions runs up the middle of these papillæ; the margin at the base takes the shape of a keel, ending in a small tooth at the shoulder. There is no longitudinal keel starting from this and running up the elytra. There is no appearance of larger impressions upon the striæ. There is some appearance of the papillæ spreading themselves in a very faint form near the apex. The under side is not so smooth as the upper. The segments of the abdomen are very finely granulated. The prosternum and mesosternum have a number of minute, scattered papillæ on their sides, and the back part of the under side of the head is slightly rugose or granular. Two distinct punctures occur, one on each side of the middle of the abdominal segments, the last segment having another puncture on the exterior margin; the first and second segments are soldered together, and appear as one. The anterior tibiæ are tridentate, with four smaller distinct teeth behind them. The inferior surface of the palmated space is transversely corrugated. The middle tibiæ have two larger teeth projecting near the apex, and a number of minute denticulations behind them.

2nd Division. *Intermediate tibiæ with only one prominent projecting spine.*

4. *S. rotundicollis*, mihi.

Niger, nitidus; antennis pedibusque ferrugineo-brunneis; tibiis anticis tridentatis, postice unidenticulatis; capite fronte bifoveolato et antice bipunctato; thorace angulis posticis rotundatis, et intra eos leviter papilloso; elytris curtis, obovatis, striatis, punctis tribus impressis.

Long. $7\frac{1}{2}$ lin., lat. $2\frac{1}{2}$ lin.

Black, with the antennæ and legs ferruginous brown. Man-

dibles with two longitudinal carinæ, and several smaller carinæ within them sloping obliquely inwards. Labrum tridentate; front of head with a tooth projecting on each side of labrum, and one or two longitudinal grooves beside these teeth; two longitudinal foveæ on each side of the front at equal distances between the eyes, deepest in front; and on each side, a little on the exterior and in front of their termination, is a round, flat-bottomed puncture with a depression in its centre, and a faint line leading from this towards the anterior corner of the head; the eyes with a very slight, scarcely observable tumour behind and below them. Mentum longitudinally rugose, two elongate foveæ in the middle, the space between which forms a ridge, which becomes the point of the middle tooth. Thorax somewhat quadrate, with the posterior angles rounded behind from the tooth on the margin, and alongside and within them a few small papillæ gathered together; margined both on the sides (which are slightly rounded) and behind, but not in front; dorsal line faint, not reaching to the front. Scutellum situate on the peduncle, transverse, smooth, with a ridge across; prescutellar space rugose. Elytra short and obovate, except at the base, which is truncate; deeply and broadly striate, particularly on the sides and apex, where the striæ are almost as broad as the interstices; the striæ impunctate; interstices impunctate and convex, particularly so where the striæ are deepest; three impressions on the third interstice (counting the sutural space as an interstice), the first more than half-way from the base, the second about a fourth from the apex, and the third on the point where the third and fifth interstices combine together shortly before reaching the apex. A few very minute papillæ at the base degenerate into a slightly rugose surface along the margin, and a row of punctures occurs on the marginal space and at the base; the margin distinct and equal all round, not being expanded; the humeral tooth distinct. Under side polished and shining; division of head behind mentum marked; punctures on segments of abdomen same as in preceding species; anterior tibiæ furnished with two long teeth, one short one behind, and a small one behind it,—so that they may be said either to be bidentate and bidenticulate behind, or tridentate and unidenticulate behind, it being doubtful whether the third tooth should go with the large teeth or the small one; intermediate tibiæ with one prominent projecting tooth, and a number of smaller and decreasing ones; posterior tibiæ without teeth.

5. *S. Clivinoides*, mihi.

Niger, nitidus; antennis pedibusque nigro-piceis; tibiis anticis tridentatis, postice unidenticulatis; capite fronte bifoveolato, foveis longitudinaliter rugosis, postice una et altera parte ru-

goso et punctato, vertice lævi ; thorace lateribus fere parallelis ; elytris parallelis, longitudine dimidii corporis, striato-punctatis, ad basin forte et lateribus leviter papilloso-rugosis, striis apice paulo lævioribus.

Long. $6\frac{1}{2}$ – $5\frac{1}{4}$ lin., lat. $1\frac{1}{4}$ lin.

Small; black, shining. Antennæ and legs nigro-piceous. Mandibles moderate, shorter than head, bicarinate, with oblique wrinkles or subcarinæ within the interior ridges. Labrum with a slight rounded projection on each side and in the middle, and a puncture in each. Head quadridentate in front, the two outer teeth longest; two deep longitudinal foveæ on each side of front, exactly behind margins of labrum. The foveæ are longitudinally rugose; from each a sinuate furrow runs backwards and outwards, and two or three others on each side start off from it or near it about the middle, faintly at first, but becoming wider and deeper as they go backwards, and stopping about the same distance from the front as the back part of the eye does; where they stop there are some smaller lines or furrows, and two or three irregularly-shaped punctures, which extend faintly across the head, except at the middle, which is smooth, as is also the space behind. The eyes are rather flat, and are somewhat encroached on behind by the integument, but there is no swelling behind them. Thorax rather broader than long, impunctate; sides nearly parallel, narrowly margined; angles rounded; tooth or fold on the sides very small; dorsal line distinct, reaching from base to anterior marginal line, and very faintly beyond it; the anterior marginal line is deep, and shows marks of punctuation, particularly on the anterior side; the space in front of this line is comparatively narrow. Pre-scutellar space rugose in the middle, and scutellum more finely so. Elytra of the length of the half of the body, with sides parallel, punctate-striate, papilloso-rugose on the inflexed portion of the base, and very faintly so with a series of punctures on the space within the margin, which is strongly raised. Viewed in profile, the margin takes a sudden descent from the humeral tooth, for about a fourth part of the length of the elytra, where it forms an angle and follows the line of the elytra; the striæ are fainter at the apex, the terminal portions of some of them being obliterated; the third and fourth striæ join together about one-fourth of the length of the elytra from the apex. Under side impunctate, except the posterior part of the head, which is faintly punctate, and the usual row of punctures on each side of the middle of the abdominal segments; mentum obliquely rugose; anterior tibiæ tridentate, with a small tooth or tubercle behind them; thighs of middle legs with a row of punctures along the under side.

CLIVINA, Lat.

1. *C. grandis*, Dej. ii. 478.

Nigra; thorace quadrato; elytris elongatis, parallelis, punctato-striatis, punctis quatuor impressis, margine tenui, macula postica, antennis pedibusque rufis.

Long. $5\frac{1}{4}$ lin., lat. $1\frac{1}{2}$ lin.

[To be continued.]

XXXV.—*Descriptions of two new species of Heteropodous Mollusca*. By ARTHUR ADAMS, Surgeon R.N.

To the Editors of the *Annals and Magazine of Natural History*.

GENTLEMEN,

South Atlantic, off Cape Frio.

Since writing my last note on the Equator, two species of *Sinusigera* of D'Orbigny, or *Cheletropis* of Forbes, have occurred to us among the contents of the towing-net, and both different from *S. Huxleyi*, Forbes. One is of a dark reddish-brown colour, with an elevated spire, and keeled on the last whorl; the other is of a delicate pink or flesh-colour, and is much more globose; both species are finely reticulated. The dark species I presume to be that originally described by D'Orbigny, *S. cancellata*; the other species I have dedicated to that eminent naturalist and accurate observer. The animal, so well figured and described by Mr. Macdonald of the "Herald," is by no means shy, and appears to employ the cephalic arms for reptation, crawling head downwards somewhat in the manner of an *Octopus*; they also answer the purpose of tentacular arms for the capture and retention of the minute crustaceans on which they prey. The genus *Sinusigera* belongs to the family *Macgillivrayidae*, established by my brother and myself in our 'Genera of Mollusca,' which appears, however, to differ sufficiently from the other Heteropods to stand by itself as an independent sub-order, which might be called *Brachiocephala*. The new species may be thus characterized:—

Sinusigera D'Orbignyi, A. Adams.

S. testa turbinata, subglobosa; spira obtusa, carneola, vertice luteola, pulcherrime reticulata; anfractu ultimo ventricosus, ecarinato. Apertura semiovali; labro margine vix incrassato, lobis duobus instructo, lobo antico simplici et obtusim acuminato, postico canaliculato et ad apicem truncato.

Hab. in Oceano Atlantico Australi.

Shell turbinate, subglobose, with an obtuse spire, flesh-co-

loured, with the apical whorls yellowish; last whorl ventricose and ecarinate, the surface finely reticulated. Aperture semi-ovate; the outer lip slightly thickened and furnished with two lobes, the anterior one simple and obtusely pointed; the posterior folded in at the sides for the siphon, and truncate at the end.

Many of the genera of Pteropods, both those with shells and those with naked bodies, have been taken and recognized by me. The species of *Spirialis* also sometimes abound. The figures both of D'Orbigny and of Eydoux and Souleyet are very good; others are bad, and fail to give any idea of these forms when living; but a ship, unfortunately, is a bad place either for drawings or for peaceful study.

Rio de Janeiro, 4th Feb. 1857.

Since my last brief communication I have been fortunate enough to detect a second new species of *Macgillivrayia* from the Atlantic Ocean, which differs from my *M. echinata* in the absence of spines round the last whorl, and in the colour, form, and simple aperture, which is not armed at the fore part; from the other species of the genus it may be readily known by the upper whorls being crowned with setæ. It may be thus characterized:

Macgillivrayia setigera, A. Adams.

M. testa subglobosa, cornea, semiopaca; anfractibus quatuor, ultimo amplo, lævi, inermi, penultimo in medio angulato, serie setarum coronato et longitudinaliter delicatim costulato; nucleo subviolaceo. Apertura ovali, antice simplici, rotundato.

Hab. in Oceano Atlantico Australi.

Shell subglobose, horny, semiopaque; whorls four, the last large, smooth; the penultimate angulated in the middle, and furnished with a series of bristles directed nearly upwards, very finely longitudinally costellated; the nucleus violaceous. Aperture wide, simple anteriorly.

Numerous interesting forms of pelagian Crustacea have been captured during our delightful passage from Madeira to Rio, among which was a specimen of the *Rhabdosoma armatum* of Adams and White, two species of *Oxycephalus* of Milne-Edwards, *Squillerichthys*, *Oplophorus*, *Megalopa*, *Zoëa*, and many others.

The *Glaucus* was taken in some numbers; it has the means of distending its body with vesicles of air disposed along the front part of the back, to enable it to float the better. When becoming languid, it protrudes a long, pale, dilated proboscis:

the gills are easily shed. The *Triptera columella*, when first taken, swims vigorously about, and protrudes a proboscis which curves downwards, which it frequently rapidly retracts into the interior of the body and as rapidly exserts again. The greater majority of small oceanic Crustaceans, like a large number of other animals which inhabit the high seas, are of a deep blue colour, which, however, changes to a bright red when the animals are placed in spirit.

I remain, Gentlemen,

Your obedient Servant,

ARTHUR ADAMS.

XXXVI.—*Notes on the Permian System of the Counties of Durham and Northumberland.* By RICHARD HOWSE, South Shields.

[Concluded from p. 312.]

GASTEROPODA.

83. *CHITON LOFTUSIANUS*, King.—The general form of this Chiton, and the size it attained, are at present unknown, for the plates have never been found articulated together. It may, perhaps, be inferred, from the size of the plates that have occurred, that it was rather a small species than otherwise.

The marginal outline of the first and last plates is semicircular, that of the second unguiform. The third plate, supposed by the author of the 'Perm. Mon.' to be the second, is somewhat triangular; the fourth is slightly furcated; and the other three, assuming it had eight altogether, are oblong or strap-shaped in marginal outline. The second, third and fourth plates are broad and very oblique; the fifth, sixth and seventh, narrow and transverse. The posterior plate, which is not '*capuliform*,' but half-limpet-shaped, has its apex or mucro produced to a fine point. Seen in profile, all the plates, excepting the first or head-plate, are curved towards the posterior margin, considerably elevated along the dorsal line, and pressed down steeply on each side towards the lateral margin. The lateral areas of the intermediate valves, excepting the second, are large and distinctly defined. Occasionally a small sulcation or furrow may be seen on each side of the dorsal ridge, but this seems to be rather an accidental than a specific character. The entire surface of all the plates is minutely granulated or shagreened, and the striæ of growth are very distinct on the dorsal as well as on the lateral areas. The interior of the valves is minutely pitted or granulated. The apophyses or processes of attach-

ment of the mantle are large, nearly semicircular, and, as they are confined to the lower half of the dorsal area on each side, they are consequently very widely separated. It, perhaps, may be inferred, from the disparity in the shape and size of the plates, that this Chiton was much narrower in front than behind.

This Chiton is neither exactly described nor correctly figured in the 'Perm. Monograph,' for if the "*diagnosis*" given by Mr. King be correct, several species might be made from the valves that are found at Tunstall.

Peculiar to the shell-limestone of the North of England, in which, though not plentiful, it is very generally distributed.

34. CALYPTRÆA ANTIQUA, Howse. Pl. IV. figs. 16, 17.—In 1847 I found a single imperfect specimen of a patelliform shell at Tunstall Hill, which was described thus in the Tyneside Catalogue:—

"Shell small, patelliform, strongly ribbed longitudinally; margin crenulated; two deep furrows internally from the apex to the margin, corresponding with two strong ribs on the outer surface."

The only specimen found was not quite perfect round the margin, and the whole shell had the appearance of being irregularly grown. It was thought, however, desirable to include it in the Permian list, and to affix an epithet to it, for the sake of reference. Mr. King, not being acquainted with it, and consequently considering it a "doubtful species," placed it in the Appendix to the 'Permian Monograph' (p. 247), in which position it has been overlooked by Baron Schaueroth, who has been so fortunate, by the discovery of a specimen (*Patella Hollebeni*) from the lowest bed of the Zechstein at Ilmenau, as to be able to confirm the certainty of its existence in the Permian system. As Baron Schaueroth's specimen was more perfect than the one described above, it seems advisable to extract a portion of his description, which, so far as it can be compared, agrees with the present species:—

"The first, and at present the only known *Patella* of the Permian system has an elliptical (marginal) outline, which is slightly narrower in that part of the shell in which the elevated apex occurs, so that it is rather oval. The apex is situated in a third part of the length of the shell, and its height bears a proportion of one-third to the whole length of the shell. The surface is covered with fine, crowded, concentric, raised lines, which disappear almost entirely at the apex. The latter are crossed by gradually enlarging, radiating lines from the apex, so that the whole of the surface is cancellated or cut up into wire-work markings."

The only known English example is from the shell-limestone

of Tunstall, and the German specimen was obtained from the under layer of the Zechstein of Ilmenau.

35. *EULIMA SYMMETRICA*, King.—In the "diagnosis" given by Mr. King, the general form of this shell is incorrectly stated to be "*fusiform*." There is no fusiform shell in the Permian system that I am acquainted with, and Mr. King's own figures do not represent it as such. More correctly, the general form is subulate, as the front portion of the mouth is much the broadest part of it. The surface appears to be smooth. The spire is produced to a fine point, and the very oblique suture is closely pressed in, and is not folded over, as in those shells which are generally referred to the vague genus *Macrocheilus*. Some specimens show broad bands of colour arranged as on some of the recent *Eulima*.

The meagre description of this good species, and the unsatisfactory figures of the 'Perm. Mon.,' have led Baron Schauroth to suppose that it may belong to one of the following species; but the general form of the shell is too characteristic to allow of this conclusion being permanently entertained. It attains sometimes to more than an inch in length.

In the shell-limestone of Tunstall, not very common; also in the same deposit at Humbleton and Silksworth. It does not appear to have been found yet in Germany.

36. *CHEMNITZIA ROESSLERI*, Geinitz.—In the Tyneside Catalogue I gave the first account of a fragment of a plicated shell which evidently belongs to the above, in the following words:

"*CHEMNITZIA*.—We procured a fragment of a small shell from Tunstall Hill, which possesses more of the characters of this genus than of any other we are acquainted with. It has a few gradually-increased whorls, which are very convex and deeply fluted. The suture is deep, and the pillar straight. This may be the shell included in the tabular list of the 'Geology of Russia' as *Loxonema rugifera*. It cannot, however, be referred to that species, nor to the genus *Loxonema*, as the suture is deep, and not pressed against the former whorl, as in that genus. It is also destitute of striae." In King's 'Cat. Org. Remains of Permian Rocks,' published two days after the above, I find no shell described that can be identified with the *C. Roessleri*.

In the 'Perm. Mon.,' however, the *Chemnitzia* noticed above is affixed to a long train of names of *Loxonema rugifera*, and a new specific name, as it is called, is very quietly appended, and a "diagnosis" substituted, which would apply to a great number of species; and, in the remarks, an admission is made that "imperfect specimens, about an inch in length, of a species resembling *Loxonema rugifera*, Phillips, have twice occurred to me; but through some accident, they have been mislaid."

Now, unless these "missing specimens" have since been found, there does not exist a type-specimen of *Loxonema Swedenborgiana*, King, according to this author's own statement; and why then should paleontology, grievously overburdened already, be pestered with another unauthenticated name?

As Mr. King's "diagnosis" and remarks do not apply to my shell, I prefer adopting the one proposed by Dr. Geinitz, especially as the same shell has been further mentioned and figured by Baron Schaueroth (Zeitschr. d. deutschen Gesellschaft Jahrg. 1854, s. 558. taf. 21. fig. 9). But, in his last work, Baron Schaueroth has given a preference to King's name without assigning any reason for the change, and he also seems inclined to think that it is only a variety of the following species.

It is more turreted than the *C. Altenburgensis*, and the plications do not appear to be accidental, but permanent and of specific value. Specimens that have occurred are about half an inch in length.

Collected in the shell-limestone of Tunstall and Humbleton by Mr. Kirkby and myself, and in Germany it is mentioned by Dr. Geinitz and Baron Schaueroth.

87. *CHEMNITZIA ALTENBURGENSIS*, Geinitz, sp. Pl. IV. fig. 18. It seems to be necessary to trace the history of the discovery of this little shell, which has been described within the last ten years under five or six different names, in order to establish the epithet adopted above for this species.

It is, I believe, first mentioned, in the following words, in Prof. Sedgwick's paper on the "Magnesian Limestone, &c. of the North of England," Geol. Trans. 2nd ser. vol. iii. p. 118:—

"To this list may be added (five *errat.*) a species of *Melania*? less than half an inch long, with eight whorls; Hawthorne Hive. (MS. Catalogue by Mr. J. Phillips.)" No specific name is applied to it.

The next mention of it (unless the *Murchisonia subangulata*, Vern., be the same shell), and the first accompanied with a short description, figure, and specific name, is by Dr. Geinitz in the 'Versteinerungen des deutsch. Zechsteingebirges,' p. 7. tab. 8. figs. 9, 10. The short description is in the following words:—

Turbonilla Altenburgensis, "a little tower-shaped snail, with six or more rounded, smooth whorls," &c.

Next, in the Tyne-side Catalogue, p. 240, it is thus characterized:—

"*TURRITELLA PHILLIPSII*, n. s. Shell elongated, narrow, slightly tapering, turreted; spira with 12 or more rounded whorls, which are rather convex and slightly flattened behind; suture deep; pillar-lip slightly angulated in front; aperture suborbicular." And "*T. TUNSTALLENSIS*. Shell elongated conical; spire with 8

whorls, which are much rounded, smooth; suture deep; aperture orbicular."

Notwithstanding the differences pointed out, after examining a large series of specimens, I am now of opinion that the latter shell is only a variety of the former.

The next two notices of this shell are by Mr. King, 'Cat. Org. Remains,' &c. p. 18, and 'Perm. Mon.' pp. 209, 210. In both these works it has the following "diagnosis" :—

"*LOXONEMA FASCIATA*, n. sp. *A subulate, many-whorled, smooth species, with two or more dark-spiral bands, crossed by others, on a light ground; its outer lip is inversely sigmoid."*

If this "diagnosis" had not been accompanied with a figure, I could not have identified it with the preceding shells; but the figure in 'Perm. Foss.' tab. 16. f. 80, establishes its relationship to them without doubt, and at the same time it shows that Mr. King's "diagnosis" of the species is incorrect. The general form is not "*subulate*," but turreted, or tower-shaped, as Geinitz expresses it. The terms "dark-spiral" and "inversely sigmoid" are not very intelligible.

In 'Perm. Mon.' Mr. King places both the *Turritella* described in the Tyneside Catalogue with his *L. fasciata*. This would not have surprised me in the least, had he not immediately afterwards (Perm. Mon. p. 210) redescribed the *Turritella Phillipsii* under a new specific name, *Loxonema Geinitziana*. That the shells described under both these names are identical, cannot be denied by any one able to admit the truth; and it is certainly much to be regretted that such an oversight as this and many others pointed out in this paper disfigure the fair pages of the 'Permian Monograph.'

In the 'Journal of the Dublin Geol. Soc.' April 1856, Mr. King mentions, under the name *Rissoa? Altenburgensis*, Gein., the occurrence of this little shell in the Permian rocks of Ireland.

Lastly, in Germany, Baron Schauroth, in his last contribution on Permian Fossils (Zeitschr. d. deutschen geologischen Gesellschaft Jahrg. 1856, s. 241, 242), adopts for this species King's inappropriate epithet *Geinitziana*, and unites with it the *L. fasciata*, King, and the *Turbonilla Altenburgensis*, Geinitz. In the same paper the *Loxonema Geinitziana*, King, is redescribed under the new name *Rissoa gracilis*. I have been favoured by Baron Schauroth with some carefully-made clay-casts of these shells, and I think they are perfectly identical with those from the English Permians.

All the shells enumerated above are, I believe, referable to one species; and the name given to it by Geinitz originally ought to be adopted for it at present.

In addition to the characters given above under *Turritella Phillipsii*, it may be stated that in very many specimens the whorls are very much flattened or bevelled, both above and below, causing a deep suture, and the middle part of the whorls to appear as if doubly keeled. In some few specimens, indeed, there are indications of obsolete spiral striae, and Mr. Kirkby has collected one specimen in which the last two whorls have several very strong spiral striae, though the other whorls have the smooth normal appearance only. This tendency of the whorls to a double keel inclines me strongly to think that the *Murchisonia subangulata*, Geinitz, is only the same shell; and it may also happen that the original Russian *M. subangulata*, Vern., is identical with the present species. Some of Mr. Kirkby's specimens also show two or three coloured spiral bands running round the whorls parallel to the suture, as figured by Mr. King in the 'Perm. Mon.'

It occurs in the shell-limestone of this district, chiefly at Tunstall.

38. LITTORINA HELICINA, Schloth. sp. Pl. IV. figs. 19, 20, vars.

Most authors describe the typical form of this species as having only three or four whorls, yet all the best full-grown specimens have five or six. The nucleus of the shell and the succeeding whorl are quite smooth, and in a few instances this smoothness is continued through the whole period of growth. This variety is termed *Rissoa obtusa*, Brown, and *Turbo Permianus*, King. Generally, in the typical *L. helicina*, after the first two or three whorls, the shell begins to be ornamented with more or less numerous, much or slightly developed striae running parallel with the suture, which are fewer, stronger and more prominent on the middle, and fainter and more numerous on the lower part of the whorl. The spire also in some instances is much drawn out, in others much depressed, causing the body-whorl to appear in the latter case much larger than usual. The ornament of the shell has sometimes the form of flattened, angulated planes over the upper part of the whorls, which are in a few instances so obscure as to be scarcely perceptible (see Pl. IV. figs. 19, 20), and it is thus that the typically ornamented forms are united with the smooth variety above mentioned. I can find no character by which to distinguish the *Turbo Mancuniensis*, Brown, from this, which certainly is identical in its common form with typical specimens of *Trochilites helicina*, Schloth., received from Germany. A glance at the figures in the 'Perm. Mon.' tab. 16. f. 19-22, is sufficient to convince any sound naturalist of the identity of *helicina* and *Mancuniensis*.

The form which was separated under the epithet *L. Tunstall*.

ensis in the Tyneside Catalogue, and in the 'Cat. Org. Rem.' under the specific name *Turbo Thomsonianus*, must also be referred to the *L. helicina*. It is smaller than the typical form of *helicina*, and the spire is considerably drawn out, which gives the whorls a much rounder appearance, and the striæ are finer and closer to each other, and do not affect the rotundity of the whorls, as in typical individuals. The *Rissoa Gibsoni*, Brown, appears to be only a cast of this variety, which is also described by Geinitz as *Trochus pusillus*, Verst. pl. 3. f. 15, 16.

King's *T. Taylorianus* is, I think, a very stunted form of this species. It has the spire only very slightly elevated, and the striæ are more numerous, more closely set and thicker in appearance than usual.

To the typical form of this species, *Trochilites helicina*, Schloth., may be added the *Turbo Mancuniensis*, Brown, and the *Turbo minuta*, Brown.

In the first variety may be placed *Rissoa obtusa*, Brown, *Natica minima*, Brown, and *Turbo Permianus*, King; and in the second variety, *Rissoa Gibsoni*, Brown, *Trochus pusillus*, Geinitz, *Littorina Tunstallensis*, Howse, and *Turbo Thomsonianus*, King.

Note on the originals of Capt. Brown's species.—*Turbo Mancuniensis*. Mr. Binney's three original specimens of this shell, from the Permian marls of Lancashire, are rather more obtuse in the spire than those from the shell-limestone of this district. The whorls have also a more rounded appearance. One of the specimens was worn, and very much rubbed. The other two had the markings sharp and well defined. Aperture nearly circular, with a slight notch behind the pillar-lip, but no umbilicus. The largest specimen, which shows the mouth, not quite perfect, is $\frac{1}{4}$ of an inch in length. It has three strong ribs on the body-whorl, with an intermediate faint one above, and several smaller, closer striæ beneath. The two specimens of *Turbo minutus* in the same collection are undoubtedly, as I pointed out formerly in the Tyneside Catalogue, only the younger state of *T. Mancuniensis*, as is well shown by the unfinished state of the mouth of one of the specimens.

Two of the original casts of *Rissoa obtusa*, Brown, are not in a state good enough to describe. One of them is very much compressed. The other specimen is more perfect than these, but is also a cast. It has four rounded whorls and a short spire, but the apex is not quite perfect. The *Natica minima*, Brown, a cast with imperfect spire, is undoubtedly the same as *R. obtusa*. The originals of Capt. Brown's *Rissoa Gibsoni* are also casts. Two of them are very much compressed, so that the spire has not the natural appearance. The third speci-

men closely resembles the *R. obtusa*, but its spire is longer, being more perfect than the others at the apex.

The estuarine character of these Lancashire shells was pointed out, many years ago, by Mr. Binney, in the 'Manchester Geological Transactions,' vol. i., and this opinion was very forcibly impressed upon me when examining the originals belonging to that gentleman. The larger and more typical individuals from the shell-limestone of Durham have probably lived in less-confined habitats, but still they have a decidedly littoral character. It must be mentioned here, that I have used the term 'littoral' in contradistinction to 'pelagic,' and not in the limited sense in which it is used by British naturalists.

This species occurs in the middle and upper divisions of the magnesian limestone, but the most typical and finest specimens are from the shell-limestone of Tunstall.

39. *LITTORINA HERCYNICA*, Geinitz.—This species had been described and figured by Dr. Geinitz in the 'Versteinerungen,' several months before Mr. King's imperfect notice of it in the 'Cat. Org. Rem.' appeared. It was identified in the Tyneside Catalogue with *Natica minima*, Brown; but an examination of the latter proves this identification to be incorrect. Dr. Geinitz and Mr. King both place this shell in the genus *Natica*, but it is rather difficult to comprehend why they do so, for it has a nearly orbicular mouth, is not apparently a polished shell, is not umbilicated, and bears a strong resemblance to the *Littorina*. By comparing the mouth of this species (Perm. Mon. pl. 16. f. 28) with that of *L. helicina* (pl. 16. f. 22), it will be seen how strikingly similar to each other they are in form. In Mr. King's figures, the spire of the shell is represented much too high, and his "diagnosis" is so jumbled, that it would be in vain to hope to identify the species by it.

The surface of the shell is ornamented with very fine, wavy, longitudinal striae. This peculiar character is well displayed on some specimens collected by Mr. Kirkby at Field House.

Baron Schaueroth has lately united this species to the *Euomphalus Permianus*, King, at the same time removing the latter into the genus *Rissoa*. After examining some examples of this supposed species from both German and English localities, I think it is probably only the young of *Littorina Hercynica*. The figure given by Mr. King, with its few whorls and unfinished mouth, is evidently only a young shell.

In the shell-limestone of Tunstall, Silksworth, and Field House, but not common.

40. *PLEUROTOMARIA ANTRINA*, Schloth. Pl. IV. figs. 21, 22, 23, 24, 25.

In well-preserved specimens of this shell, the whole of the

surface is ornamented with distinct longitudinal lines, but they are never so much raised as in the following species, and the surface never presents the same finely decussated appearance. In young specimens the suture follows the line of the fissure of the preceding whorl, but it falls considerably below it in some adults, which have consequently a less conical appearance. The upper surface of the whorls is either slightly arched or nearly flattened, and this variation is respectively represented on the under surface, which has, in the latter case, a flattened, truncated, and in the former a tumid appearance. These variations are shown in the figures referred to in the accompanying plate.

The false species and erroneous identifications of this very characteristic shell are corrected in the Table given at p. 39; but the last two synonyms must be cancelled, for reasons stated under the preceding and under the following species.

Rather plentiful in the shell-limestone of Tunstall, but rare in several other localities.

41. *PLEUROTOMARIA VERNEUILI*, Geinitz.—I find, since the Table of species was printed, that Baron Schauroth has identified the *Pleurotomaria nodulosa*, King, with the *Pleurotomaria Verneული*, Geinitz. As this identification is undoubtedly correct, and as Geinitz's description and figure appeared several months before King's Catalogue, the name adopted above has right of priority.

In well-preserved specimens the whole surface of the shell is ornamented with strong, longitudinal, raised lines, which being out obliquely by the strong lines of growth, give the whole surface a beautifully decussated appearance. The double row of nodules is not so persistent a character as the former, for the sutural row is not seen on young individuals, and the row placed below the fissure becomes obsolete in very large full-grown specimens. It appears to have been the most beautiful and delicate shell of the Permian seas, and from the numerous examples of bored shells that occur,—a fact which I first pointed out to Mr. King,—it probably, with its congener *P. antrina*, preyed upon its more peaceful and unprotected neighbours.

The specimen figured in 'Perm. Mon.' is a young individual. The largest specimen I have seen exceeded an inch in length and width.

It occurs in the shell-limestone of Tunstall and Humbleton.

CEPHALOPODA.

42. *NAUTILUS FRIESLEBENI*, Geinitz. Pl. IV. fig. 26, *juv.*

If, instead of dismembering this fine species, Mr. King had endeavoured to trace its variations through all its periods of

growth up to the adult state, he would have deserved our best thanks, and would have contributed something towards the full understanding of its true character. But it has pleased him better, instead of so doing, to represent and describe the young of it as a new species,—*N. Bowerbankianus*. The last chamber only is the part principally represented of *N. Frieslebeni*, and from it the characters of the whole shell, with the aid of Geinitz's description, appear to be drawn; for the figure, pl. 17. fig. 16, does not contribute much towards the elucidation of the species.

If one examines the principal characters of Mr. King's new species, viz. "*deeply umbilicated; whorls increasing rather rapidly in size; slightly embracing (?) each other,*" it will be seen that they are only the characteristics of young individuals; if they are anything more, it will be necessary, in order to establish the specific identity of *N. Bowerbankianus*, for Mr. King to represent the young state and mode of growth of *N. Frieslebeni*, and show in what points they differ. Until this has been done, it is better to consider *N. Bowerbankianus* as the young state of the present species.

Very young specimens are much rounded in form, and ornamented with strong, decussated striæ. The outer chamber of Mr. Kirkby's largest specimen is nearly 4 inches in length, and $2\frac{1}{2}$ in greatest breadth.

In the shell-limestone of Tunstall, Humbleton, Dalton-le-dale, &c., and, according to Mr. King, in the compact limestone of Whitley.

PTEROPODA.

48. THECA? KIRKBYI, n. s. Pl. IV. fig. 27, *restored*.

Shell straight, tapering gradually; aperture transversely oval; surface with small, transverse, wavy furrows: four thin decurrent wings run along the whole length of the shell.

This is the only Pteropod that I am acquainted with in the English Permians. The restored outline in the accompanying plate will serve to give an idea of its form and size. I have found only one specimen which shows the above characters, and which indicates probably a closer alliance with the *Creseis*, Rang, than with the genus in which it is provisionally placed.

It is dedicated, with great respect, to Mr. James Kirkby of Sunderland.

From the shell-limestone of Tunstall.

It seems desirable to substitute the term "Botryoidal" for the epithet Conglobated, proposed in a former part of this paper;

and the term "Cellular" is also perhaps less objectionable than the term Concretionary.

In the Section at p. 36, the "Upper yellow limestone," *a, a*, ought to have been represented conformable to the beds beneath.

Several errors have, I fear, crept into the nomenclature in the Synoptical Table. I have corrected some of these in the remarks. The specific names of the following species require either correction or confirmation, viz. *Spirifer undulatus*, *Gervillia antiqua*, *Myacites elegans*, *Myoconcha modioliformis*. The last-mentioned species will also probably require to be removed from the genus *Myoconcha*.

On a future occasion I hope to make a few remarks on the remaining portion of the fauna of the Permian System.

EXPLANATION OF PLATE IV.

Figs. 1, 2. *Productus latirostratus*, Howse, from the shell-limestone, Dalton-le-dale.

Figs. 3, 4. *Camarophoria Humbletonensis*, Howse, from the shell-limestone, Humbleton.

Figs. 5, 6. *Spiriferina cristata*, Schloth. sp., from the shell-limestone, Tunstall.

Fig. 7. *Solemya normalis*, Howse, from the shell-limestone, Humbleton.

Figs. 8, 9. *Solemya abnormis*, Howse, from the shell-limestone, Silksworth.

Figs. 10-13. *Edmondia elongata*, Howse, from the shell-limestone, Tunstall and Humbleton. 11. Cast showing fissure left by the subumbonal blade or plate. 12. Hinge-margin removed, showing the form of the subumbonal blade.

Figs. 14, 15. *Tellina Dunelmensis*, Howse, from the shell-limestone, Humbleton.

Figs. 16, 17. *Kalyptæa antiqua*, Howse, from the shell-limestone, Tunstall.

Fig. 18. *Chemnitzia Altenburgensis*, Geinitz, sp. = *Turritella Phillipsii*, Howse, from the shell-limestone, Tunstall.

Figs. 19, 20. *Littorina helicina*, Schloth. sp.; varieties with nearly obsolete spiral bands, from the shell-limestone, Tunstall.

Figs. 21-25. *Pleurotomaria antrina*, Schloth. sp. 23. Typical form and varieties, from the shell-limestone of Silksworth and Dalton-le-dale.

Fig. 26. *Nautilus Frieslebeni*, juv., Geinitz, from the shell-limestone, Silksworth.

Fig. 27. *Thaca? Kirkbyi*, n. s., from the shell-limestone, Tunstall.

Fig. 28. *Retepora Ehrenbergi*, Geinitz, from the shell-limestone, Silksworth: *a*, portion of the large individual figured in 'Perm. Mon.' t. 5. f. 1; *b*, young individual; *c*, fragment enlarged, showing interstices and polype-cells; *d*, fragment slightly enlarged, showing the reverse or non-celluliferous surface.

Fig. 29. *Caryophyllia quadrifida*, Howse, from the shell-limestone, Humbleton: *a, c*, coral-stem, natural size; *b*, cast showing the position of the laminae or plates.

XXXVII.—Notes on *Sepia biserialis* and *Sepia elegans*.

By J. ALDER.

To the Editors of the Annals of Natural History.

GENTLEMEN,

In a paper communicated to the Linnæan Society, and published in the 8rd Part of their 'Proceedings,' Mr. Couch announces his having found ten specimens of the dorsal plate or bone of *Sepia biserialis* on the Cornish coast. On a careful perusal of his description, however, I am inclined to think that Mr. Couch has mistaken the species, and that the plates he found belong to *Sepia elegans*, Blainv., a species not before known to be British.

Sepia biserialis is a small species, the bone of which does not exceed $2\frac{1}{2}$ inches in length, but 2 inches is the more general size. It tapers gradually to a point below, where it is much curved inwards (as may be seen in pl. PPP. fig. 2c of 'British Mollusca'), and has no spur, but only a slight keel or ridge at that extremity. *S. elegans* is considerably larger: its dorsal plate is usually $3\frac{1}{2}$ inches long; it is more ovate in form than that of *S. biserialis* (though less so than in *S. officinalis*), and is distinguished by the very strong spur, which is a little compressed laterally, so as to form a slight ridge before and behind: the plate is not so much curved inwards below as in the former species. This agrees with the description of Mr. Couch. Professor Edward Forbes has suggested that these may be only different sexes of the same species; but this opinion, I suspect, was hazarded without having seen specimens, an inspection of which would, I think, have led to a different conclusion. Professor Verany has kindly sent me specimens of both kinds from the Mediterranean.

There can be little doubt that the Cuttle-fishes whose dorsal plates are cast up on our shores from time to time are indigenous. With respect to *S. biserialis*, its title to be considered British does not rest solely on the evidence of dorsal plates cast on shore, as the specimen from which the description and figures in the 'British Mollusca' were taken, was extracted by myself from the stomach of a cod at Cullercoats, with the animal nearly entire, but too much decomposed for preservation.

I am, Gentlemen,

Yours very truly,

JOSHUA ALDER.

Newcastle-on-Tyne, May 1857.

XXXVIII.—On some Mites and their young states.

By A. SCHEUTEN*.

[With a Plate.]

UNDER the epidermis of the leaves of pear-trees, in black, pustular, inflated spots, the author discovered some small vermiform animals, which were pronounced to be the larvæ of Mites by Professor Troschel. The author then examined the outside of the leaves, and found mites, which had probably been developed from the little animals above mentioned. This appeared not only from their common habitation, but also from the similarity of the organs of the mouth, and the presence of two strong bristles on the abdomen of both animals. On examining a large number of spotted leaves in his garden, in which all the pear-trees were similarly attacked (one tree having a third of its leaves affected), the author always found the same larvæ in the interior of the leaves, and in most cases the mite on the exterior. On one tree a very similar larva was found with a few specimens of a different mite. This was at the end of July, and in August the author detected the same mite and larva on pear-trees at Harlem. He afterwards observed the leaves of a lime-tree, which were covered with reddish-brown spots by *Erineum rubigo*, and found on them the same larvæ and mites.

Hence it would appear that the larvæ and mites belonged to the same species, and the question of their identity becomes the more interesting, as Dugès had already asserted that the mite is produced from the larva, which was disputed by Dujardin, because he supposed that he had seen eggs in the so-called larva.

In the 'Annales des Sciences Naturelles,' 2me sér. tome ii. p. 104, a larva of the same form is described by Dugès, who asserts it to be the larva of *Tetranychus*, Dufour, partly on account of the similarity of the organs of the mouth and of the legs, and partly on account of their common habitation. Dujardin describes a third larva, so similar to that of Dugès, that he considers them to belong to the same genus. Dugès saw the larvæ become motionless and converted into pupæ; the body contracted, leaving the extremities of its envelope. Two or three times, in galls of the white willow and the lime-tree, he saw short, nimble, eight-legged mites with the palpi and legs of *Tetranychus*; they were perfectly similar to the large reddish *Tetranychus* which he also found repeatedly in larger galls. Dujardin described the animal in the 'Annales des Sciences

* Abstracted from Wiegmann's Archiv, 1857, p. 104, by W. S. Dallas, F.L.S.

Naturelles,' 8me sér. tome xv. p. 166. From the supposed presence of ova, he regarded it as a perfect four-footed mite, and gave it the name of *Phytoptus*. His only evidence of these ova was, that he saw roundish structures shining through the skin of the animal. He describes the animal as white, so that it is not transparent; and striated, so that its structure would be still less distinctly visible. Even with transmitted light, a very indistinct view of the interior can be obtained, and this is shown by his own figure. In this we see what he regards as eggs, but no trace of other viscera, for which, however, there is plenty of space.

In the interior of the author's larvæ various rounded outlines are seen, especially when glycerine is employed. In the upper part of the body especially there is constantly a round clear space, which also occurs in the same spot in the mite; then follow irregular roundings, which are certainly nutritive organs.

The differences between Dujardin's larvæ and those described by the author are in non-essential points, so that they must be regarded as species of the same genus. Dujardin describes his as a very small white vermicle, 0.15-0.23 mill. in length, and 0.085-0.045 mill. in breadth. The author's (fig. 1) is 0.10-0.18 by 0.025-0.040. The whole body is covered with transverse striæ, which, when highly magnified, proved to be very firm tubercular ribs, forming a strong shield, which could not be ruptured by pressure, &c. The animal moved slowly with its four short legs, which are inserted near the rostrum. According to Dujardin, the body is narrowed behind, and terminated by a bilobed sucker. In the author's species the body is of uniform breadth, with a blunt termination, furnished with a pair of long, undulated bristles. In turning round, the animal supports itself upon these. Between them there are two smaller ones. The sides also bear some bristles, which appear to support the long body when in motion. The legs are five-jointed, and terminated by a long nail or claw. Dujardin describes this claw as acute and curved, with a feathered, tridentate structure beneath it. In the author's species it is truncated, with a short, stiff bristle below it (fig. 2). The rostrum (fig. 3) forms a truncated cone, containing a sucking-tube. Dugès says that he once pressed a long, curved, narrow lamella out of the rostrum; the author has repeatedly seen this lamella, which is straight in his species.

Dujardin found his larvæ in the leaves of the lime-tree, into which they had penetrated from above. The pear-tree leaves had an opening beneath, and the excrescences of the lime-tree observed by the author were also on the lower surface of the

leaf. Neither of them is a gall, but probably a fungoid product; that on the lime-tree is *Erincum rubigo*.

The mites were always found on the lower surface of the leaf: that of the pear-tree (fig. 4) is so small, as to be scarcely visible on the leaf by the naked eye; so quick in its movements, that it can only be captured with difficulty; and so tender, that it can hardly be placed under the microscope without injury. It has no eyes, the place of which appears to be taken by the anterior legs, with which it is constantly feeling about. The long palpi are also in constant motion, and bent downwards. After death the legs and palpi contract closely together.

The form of the mite is oval; its length 0·30–0·34 mill., and its breadth 0·17–0·19 mill. The parts of the mouth are conical, acute, and retractile. The five-jointed palpi are strongly hairy and obtuse, with the apical joint set with bristles. The antennal jaws are undistinguishable in the living animal; but in glycerine preparations, two claw-like jaws are seen (fig. 5). The palpi are half-analgamated with the rostrum. The legs are seven-jointed, the first pair distinctly longer than the rest, the two intermediate pairs shortest. The tarsal joint is furnished with a small funnel-shaped sucker, which can be contracted, so as to appear like a simple claw on the first pair of legs, when employed in feeling. Behind the rostrum is a translucent spot, and there is another at the hinder part of the body; the rest is opaque, and partly of a reddish colour. No intestines or circulation could be distinguished in the living animal.

The author once met with a remarkable form intermediate between the larva and the mite (fig. 6). It was of the form of the mite, but much smaller; it possessed the four pairs of legs, the anterior forming stumps; the posterior styliform, terminating in two bristles, and the first of them two-jointed.

The second larva, found on a pear-tree (fig. 7), was doubly-conical, forming an irregular rhombus with rounded angles. Its size was nearly the same as that of the first larva, and the legs and rostrum were similarly placed. The strise were undulated, and the bristles differently arranged. This form rarely occurred, but it was found at last amongst the very numerous specimens of the former species upon the first pear-tree. The perfect mite has not been found.

The larva found on the leaves of the lime-tree (fig. 8) was vermiform and dark brown; the strise are only visible by the employment of glycerine. It is 0·10 mill. in length, and 0·37 mill. in breadth. The four 5-jointed legs are longer than in the first-mentioned species, but the relative position of the legs and rostrum is the same. A sucking-tube of 0·01 mill. in length was seen in one individual. The body is undulated, somewhat

narrowed behind, and terminated by two strong bristles, with two short ones between them. On each side there are one strong and two weaker bristles. The tarsal claw is somewhat curved, with a tridentate structure beneath it, and above it a strong bristle (Pl. XIV. fig. 10).

The mite (fig. 9) is short and obtusely pyriform; 0.40 mill. long, 0.22 broad in front, and 0.11 behind. The sides are undulated between the second and third pairs of legs. The legs are seven-jointed, and the two intermediate pairs somewhat shorter than the others. The tarsal joints have two thin, straight claws and a small sucking-disk. The palpi are indistinctly jointed, with the last joint almost always bent inwards, so that it can rarely be seen; they are half-amalgamated with the rostrum, from which the author once saw the sucking-tube protruded. The body is terminated by six short bristles, and on each of the prominences of the undulated sides is a simple bristle. The eyes are wanting. The colour is brownish-white, and quite opaque.

The author also describes another mite which he met with only four times upon the leaves of the pear-tree. It occurred in three different stages of development. The smallest was 0.24 mill. long and 0.18 mill. broad; the second, 0.32 and 0.24 mill.; and the largest, 0.48 and 0.34 mill. The body of the mature animal (fig. 12) is oval; the rostrum conical, with the three-jointed acute palpi half-amalgamated with it. The seven-jointed legs are terminated by two claws and a globular sucker beset with bristles. The body is green, with black points, and with a broad white band down the middle, in the fore part of which is a large, triangular, red spot. On each side, above the second pair of feet, is a large, red, eye-like spot, and behind this a white oval one. The body is also regularly set with small white points or papillæ.

The body of the young animal (fig. 11) is not oval, but rhomboid, with the angles rounded; the colours and markings are essentially the same. The diffused red eye-spots are here circular, and project like eyes. Instead of the white points of the mature form, triangular papillæ are attached in this by their apices. Of these there are six close together at the posterior extremity, two on each side between the second and third pairs of feet, one on each palpus, two on the apex of the rostrum, and several symmetrically arranged on the body, giving the animal a curious aspect.

For the first-described mite of the pear-tree, which belongs to the family of the *Gamasei*, and which appears to be undescribed, the author proposes to form a new genus under the name of *Typhlodromus*, in allusion to the blindness of the ani-

mals and their rapidity of motion. The species he calls *Typhlodromus Pyri* (figs. 1-6). For the lime-tree mite he proposes the name of *Flexipalpus Tiliae* (figs. 8-10); and he calls the green species last described, *Sannio rubrioculus* (figs. 11, 12).

EXPLANATION OF PLATE XIV.

- Fig. 1. Larva of *Typhlodromus Pyri*.
 Fig. 2. Foot of the larva.
 Fig. 3. Rostrum of the larva.
 Fig. 4. *Typhlodromus Pyri*.
 Fig. 5. Its rostrum, with the antennal jaws.
 Fig. 6. Half-developed *Typhlodromus*.
 Fig. 7. Larva of another species of *Typhlodromus*.
 Fig. 8. Larva of *Flexipalpus Tiliae*.
 Fig. 9. *Flexipalpus Tiliae*.
 Fig. 10. Foot of the larva.
 Fig. 11. *Sannio rubrioculus*, young.
 Fig. 12. *Sannio rubrioculus*, mature.

BIBLIOGRAPHICAL NOTICES.

Manual of the Botany of the Northern United States. 2nd Edition.
 By ASA GRAY, Professor of Natural History in Harvard University.
 8vo. New York, 1856.

WE had the pleasure, in the year 1848, of recommending to botanists the first edition of this excellent work, which consists of a condensed account of the plants of the Union, from Maine to Virginia and Kentucky, and from the Atlantic to the Mississippi. The Flora included in the present edition is therefore more extensive than that treated of in the former. Moreover, the whole book has undergone careful revision, and in many cases is improved.

It is unnecessary to enter much into detail concerning such a work from the pen of such a writer, but a few remarks may be allowable. *Illecebreæ* and *Scleranthaceæ* are combined with *Caryophyllaceæ*, as seems most natural, although the latter order is removed by some botanists to the neighbourhood of *Chenopodiaceæ*, its relationship to which is not apparent. It seems probable that the *Sagina procumbens* of the States differs from that of Europe, for the latter does not inhabit "springy places," nor do the characters, as found in the European and American Floras, accord in a satisfactory manner. *Spergularia* is employed as the name of the genus called *Lepigonum* by Wahlenberg and others. The latter is the older name, as applied generically; for the supposed origin of the former with Persoon is erroneous, he using it only to designate a section. We wish that Dr. Gray was alone in this departure from the recognized laws of nomenclature. We are sorry to see Moquin-Tandon followed in the arrangement and nomenclature of the *Chenopodiaceæ*. Surely a less natural combination than that of *Chenopodium rubrum*, *C. bonus-Aenricus*, and their allies with *Blitum* could not easily be found; also that eminent French botanist is singularly inattentive to the law of

priority in naming his plants; nor, when neglecting it, can his alterations usually be considered as improvements. Under *Polygonum aviculare* we find the *P. maritimum*, &c., of Ray (it should be *P. marinum*) placed as the synonym of a variety, which is called *littorale* after Link, and the *P. Roberti* (Lois.) added. This is erroneous, as Dr. Gray will probably admit when he has read the remarks of Grenier (*Flore de France*, vol. iii. pp. 51 & 52) upon these plants. There appears to be no valid cause for doubting that *P. littorale* (Link) is synonymous with the above-quoted plant of Ray and the *P. Rati* of Babington; and that the *P. Roberti* (Lois.) is closely allied to *P. aviculare*, if, indeed, it is more than a maritime state of that species, having none of the distinctive characters of the *P. littorale*.

But we will not enter further into such minute points, and simply add that Dr. Gray's book deserves our highest approbation.

A Dictionary of Botanical Terms. By the Rev. J. S. HENSLOW, M.A., Professor of Botany in the University of Cambridge. Post 8vo. Groombridge, London.

We have just received a copy of this botanical glossary, and are able to award to it a considerable amount of praise. It is issued from the press in an elegant form, and is illustrated "by nearly two hundred cuts." Although small, these cuts are usually quite sufficient to convey the requisite information; but nevertheless, we should have been pleased to have seen them executed upon rather a larger scale.

As the book was issued very slowly, in connexion with Maund's 'Botanist' and 'Botanic Garden,' some slight discrepancy between the mode of treatment of terms in its earlier pages and that of similar ones occurring towards the end of the alphabet, is not wonderful. The author's plan improved as he advanced with his task.

The intention seems to have been to include all the terms which are used technically in botany, and, to a great extent, this has been done. As many of the terms can scarcely be said to be now in use, we wish that the Professor had marked those which he considers obsolete.

Professor Henslow is well known to possess an especial power of conveying to his pupils the meaning of the hard words used in botany in far too great abundance, and to the employment of which he is thought to be more attached than we think desirable; we therefore expected to find the definitions both clear and excellent in this book, and are not disappointed. Upon the whole, we consider this Dictionary one of the best that has appeared, and strongly recommend it. It is convenient in size, cheap in price, and at the same time contains, as we deduce from a remark in the preface, about 2000 words.

After rather a careful examination of it, we do not find much to notice as requiring amendment: certainly *lacinate* is wrongly explained by *fringed*: *asper* is omitted, and its definition transferred

to *scaber*: no distinction, such as is now usual, is made between *triangular*, *triquetrous*, and *trigonus*: *cuspidate* is defined as almost, if not quite, synonymous with *acuminate*, but most modern descriptive botanists distinguish carefully between them, considering a cuspidate organ to be one which is abruptly acuminate, i. e. bluntly rounded at the end, but with a point large at its base but gradually narrowed upwards placed upon it.

The British Botanist's Field-book: a Synopsis of the British Flowering Plants. By A. P. CHILDS, F.R.C.S. Post 8vo. London, 1857.

We are sorry that it is not in our power to give a favourable account of this book, for the author's object is manifestly good. He has undertaken that which we believe to be nearly impossible, namely to produce a book containing "the essential marks, and those alone, by which each order, genus, and species may be distinguished." Modestly, he does not pretend to have fully succeeded, but the very fact of publication proves his belief that to a great extent he has done so. It might be supposed that the task is not so very difficult, for we find authors like Arnott and Babington giving, in their respective Floras, something which at the first view might be supposed to supply the materials for such a book as this before us. Upon a more careful examination, it will be found that this is far from being the case; for Dr. Arnott's tabular views of the orders and genera are accompanied by fuller characters, by which the group may be determined with greater certainty; and the italicized parts of the specific characters in Mr. Babington's Manual are so prepared as to help in the determination of the species by showing to what point it is desirable that attention should primarily be given, but do not profess to distinguish the species from all its allies inhabiting this country, far less from those found upon the European continent, for an examination of the remainder of the character is requisite to do that. Even supposing that the present author had succeeded in his object, we should consider the book as likely to be more injurious than otherwise to the science of botany. Great advances have been made of late years in our knowledge of the plants of Britain, and many additions to the list discovered, which even Mr. Childs allows to be deserving of notice. But would this advance have taken place if our descriptive books had been written by men who confined their study to Britain alone, or, if their reading was more extensive, showed no trace of it in their books? Should not we have remained in the condition in which botany stagnated for so many years, when collectors were satisfied if they could force their specimens to conform to some description given in the works of Smith; and when it was supposed, as we well remember, that no new plants remained to be added to our flora? In the book before us, and in others in this respect resembling it, which we have thought it unnecessary to notice, there is nothing to cause the reader to suppose that further knowledge is desirable. He has discovered the name of his plant, or thinks that

he has done so ; has no idea that other species are allied to it, the characters of which it is desirable for him to examine ; and he—a mere collector—is led to suppose himself to be a botanist. It may, perhaps, be said that in the book before us the author disclaims all intention of advancing science ; but, as he wrote it expressly as a field-companion, and states, although incorrectly, that it is the only modern field-book which is portable, he ought to have taken care that it supplied all that is likely to be required in the field. The book should have been called “A Synopsis of the *best-known* British Plants,” for nearly all those which present the slightest difficulty or doubt are omitted, and stigmatized as the result of “minute and useless subdivision.” Our experience of students in the field has taught us that it is not the distinctive points of the common and well-known species which they require to have always at hand, for with such plants they very soon become familiar, but that the characters supposed to separate those which are dubious or critical are often asked for. Mr. Childs treats this want as non-existent, and no reader of his book alone would discover that there are such plants, or that botanists have ever differed about them. The author probably supposes that his book is to lead its readers to the use of others of a more elaborate character ; but he must know that many of them will rest satisfied without that further study, to which he certainly does not encourage them to proceed.

The proper sequence of the Orders is not determined by botanists, but most authors have thought it well to follow a uniform system founded upon that of DeCandolle. Mr. Childs has deviated from this, and arranged them in a totally different manner. His plan may be good (although we have great doubts upon the subject), but we know experimentally the extreme inconvenience caused, even to those who have made some advance in botany, by deserting the usual order. To the beginner this is of great consequence, for his facility in using other books will be much diminished by having learned to look for plants in a different position in the series from that which they occupy in all the best Floras of this and other countries.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

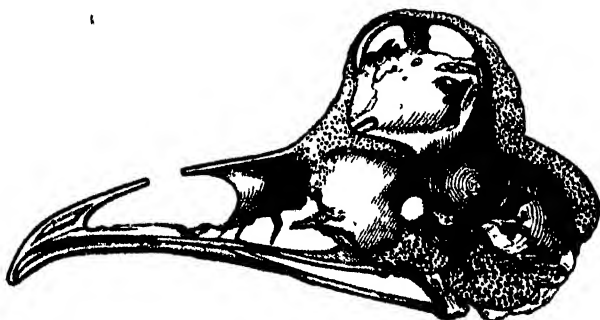
November 25, 1856.—J. S. Gaskoin, Esq., F.L.S., in the Chair.

Mr. Tegetmeier brought before the notice of the Members living specimens and preparations illustrating the very remarkable peculiarities existing in the skulls of the feather-crested variety of the domestic Fowl, now known as Polish. In these birds, the anterior portion of the frontal bone is expanded into a large spherical tuberosity or cyst, which is partly osseous and partly membranous ; the anterior portions of the brain are entirely contained in this tuberosity,

being protected from external injury solely by the feathers of the crest and the integuments; the posterior portions are situated, as



No. 1.—Skull of Crested Hen (var. Golden-spangled Polish), showing sphenoidal tuberosity and deficient intermaxillary bones.



No. 2.—Longitudinal vertical section of the skull of a Crested Cock (var. Silver-spangled Polish), showing the shape of the cavity containing the encephalon.

usual, in the cavity of the cranium: as the communication between it and the tuberosity is constricted, the brain necessarily assumes the form of an hour-glass, the anterior being the larger portion.

This very extraordinary structure, which is well developed even before the escape of the chick from the shell, was noticed by Peter Borelli in 1656, and again described with many errors by Blumenbach in 'De Nisus formativi Aberrationibus,' 1813. Blumenbach states that it is confined to the females, which is incorrect; that the fowls are remarkably stupid, whereas their instincts do not appear to differ in the slightest degree from those of the other non-incubating varieties of domestic fowl; and lastly, that the tuberosity is caused by a tight constriction of the integuments, which however does not exist.

Pallas, who also notices the peculiarity, erroneously attributes it to a cross with the *Numida meleagris*; and the description of a

very old specimen in the Catalogue of the Museum of the College of Surgeons, states it to be the result of disease, whereas it is the normal condition of all largely crested fowls.

An intimate connexion exists between the size of the tuberosity and that of the feathered crest, so that those chickens may be selected at birth that will eventually possess the largest crests.

The intermaxillary bones are usually more or less deficient in all the varieties of crested fowls, the nostrils arched, and the comb when present is crescentic or bicorned. Several of the varieties of crested fowls are destitute of fleshy wattles, their place being supplied by a ruff or beard of feathers; there is, however, no corresponding alteration in the lower maxillary bone.

Mr. Woodward exhibited preparations of the mantle and oral apparatus of the recent British *Terebratula* (*T. caput-serpentis*), specimens of which had been forwarded in a living state from Oban, Argyle, by J. Leckenby, Esq., of Scarborough. It appears that this shell, although a native of the deep sea, can live a week out of water, if placed in a bottle or tin-box with moist sea-weed. The valves are so accurately adjusted as to prevent the escape of the contained fluid. The mantle, arms and cirri of this species are frosted over with radiated *spicula*, composed of carbonate of lime, as described by Oscar Schmidt, and form a beautiful object for the polariscope. To the palæontologist this structural peculiarity is extremely interesting, as it explains the preservation of many parts of the internal organization, including the delicate *cirri*, in fossil *Brachiopoda*.

Mr. Fraser exhibited a considerable number of Birds, from the collection of T. C. Eyton, Esq., and more particularly drew attention to a singular variety of *Ramphastos discolorus*, Linn., in which the blood-red colouring of the abdomen and upper tail-coverts was replaced by chrome-yellow.

The specimen was procured from Rio de Janeiro.

He next directed attention to a species of *Trogon*, which is so nearly allied to *Trogon collaris*, Vieill., that by most writers it might be considered as identical with, or a mere variety of that species. This bird, for which Mr. Fraser proposed the name of *Trogon Eytoni*, differs, however, in having the mandibles larger and more robust; the plumage of the neck and breast of a fine coppery bronze, instead of green; the central tail-feathers bronze instead of green; and the barring of the wing-coverts and lateral tail-feathers broader, and consequently more distinct.

Total length, $9\frac{1}{2}$ inches; bill, $\frac{1}{4}$; wing, $4\frac{1}{2}$; tail, $5\frac{1}{2}$.

Hab. Rio de Janeiro.

The third specimen was a fine species of *Juida* (which Mr. Fraser proposed to call *Juida Eytoni*), nearly allied to *Juida longicauda*, Swains., but differing from that species in having the whole of the body and wings of a fine oil-green, instead of bluish-green, and in having the velvety-black marks near the tips of the wing-coverts and scapularies more conspicuous than in that species; the lower parts

of the back and upper tail-coverts of a lovely purple, changing into green on their edges and tips, in lieu of dark bronzy-purple; the band across the abdomen dark coppery-brown.

Total length, $19\frac{1}{2}$ inches; bill, $1\frac{1}{4}$; wing, 8; tail, 14; tarsi, $1\frac{1}{2}$.

Hab. W. Africa: precise locality unknown.

December 9, 1856.—Dr. Gray, F.R.S., in the Chair.

DESCRIPTION OF A NEW SPECIES OF CHELODINA FROM AUSTRALIA. BY DR. J. E. GRAY, F.R.S., ETC.

Mr. Stutchbury, who has recently returned from Australia, brought with him a series of animals which he collected during his geological researches.

In examining this collection with the intention of selecting those specimens which will be interesting additions to the very rich collection of Australian animals in the British Museum (including almost all the species described by Mr. Gould and other recent writers on the fauna of that continent), I was pleased to discover what appears to be a very distinct species of the Australian genus of Long-necked freshwater Tortoises (*Chelodina*).

To the description of this species I have added a short note on the peculiarities of two other species.

CHELODINA EXPANSA, n. s.

Shell oblong, rather depressed, broader behind, brown; plates thin, with short, narrow inosculating grooves; the margins flattened, expanded; the side of the back regularly convex; the lateral marginal plates rather broad, not revolute. The sternum flat, bluntly keeled on the sides, yellow. Head, neck and limbs dark olive above; chin, throat, and under side of the limbs whitish.

Shell, length 11, breadth 8 inches. Neck 8 inches long.

The young shell is like the adult, but the lateral margins are slightly revolute on the edges, though the plates are broad like those of the adult. The under side of the margin yellow, with a triangular black spot on the front edge of each shield; the dorsal shield thin, with three distant concentric grooves, with a rather rugose, moderate-sized areola; the areola of the costal plate subcentral; the areola of the first vertebral plate is subcentral, of the second, third, fourth and fifth vertebral plate on the middle of the hinder margin; the areola of the marginal plate is on the hinder outer margin. The front vertebral shield is large, and as broad as long; the others are much broader than long, the third being the shortest.

This species differs from *Chelodina longicollis*, *C. oblonga* and *C. Collei*, in the generally expanded form, and especially in the breadth and non-revolution of the lateral margin, and in the side of the sternum not being so sharply keeled as in the two latter species.

It differs from *Chelodina sulcifera* in the membranous character of the shields, and also in the sternum being narrow in front, like

that of *C. oblonga* and *C. Colliei*, and not expanded and broader, as in *C. longicollis* and *C. sulcifera*.

CHELODINA LONGICOLLIS.

A fine shell of the adult animal of this species, larger than any I have hitherto received, was in the collection.

The shell is rather convex and swollen on the sides, with a deep, broad, rounded concavity along the centre of the second, third and fourth vertebral plate, about two-thirds the width of the plates. The black sutural lines on the sternum are narrow and uniform.

Length of the shell $8\frac{1}{2}$; width 6 inches.

CHELYMYS MACQUARIA.

Two adult specimens of this kind were also in the series. They are both much darker than the two specimens in the British Museum Collection. They are also peculiar for having a very distinct, deep, narrow, interrupted groove along the vertebral line, deepest and widest on the fourth vertebral plate. The discal shields are also marked with rather deep distinct radiating grooves, which are evidently indentations in the bones of the animal, only covered by the very thin skin-like shields.

Shell, length 11, breadth 8 inches.

ON SOME FISH FROM ASIA MINOR AND PALESTINE. BY SIR JOHN RICHARDSON, C.B., F.R.S. L. & ED. ETC.

Through the kindness of Dr. Gray of the British Museum, I have been permitted to examine a small collection of Fish made by H. Poole, Esq., in Palestine and Asia Minor. Though they do not present to the ichthyologist any novel generic forms, they are interesting on account of the localities in which they were found.

CYPRINODON HAMMONIS, Cuv. et Val. xviii. 169.

This small fish was taken in a marshy spot, on the immediate beach of the Dead Sea, at Usdum, the supposed site of Sodom. The marsh, which contained some very small puddles of salt-water in which the fish were swimming, and from whence they were scooped out with ease by the hands, is fed by a saline spring which issues somewhat higher up, and is so little above the level of the sea, that Mr. Poole believed that the fish were washed into the pools by the waves. The opinion that the exhalations of the Dead Sea are immediately fatal to animal life, and that not even a bird can fly over it, has long been exploded. One of Mr. Poole's companions bathed in it daily with impunity, and even fancied that in diving he had discovered the remains of a ruined city under its waters, opposite to Usdum. Mr. Poole also observed ducks diving in it, and concluded, justly we think, that they must have found something edible to induce them to repeat that act, which they did frequently. *

Lieut. Lynch of the U. S. Navy examined the water of the Dead

Sea (Exp. to Jordan, &c. p. 377) with a powerful microscope, and found that it contained no animalcula and no vestige of animal matter. Its specific gravity was 1·13, compared with distilled water as 1·0, while water of the Atlantic from lat. 25° N. and 52° W. longitude was 1·02. Another examination of the water of the Dead Sea, quoted on the last page of Lieut. Lynch's book, gives its specific gravity as 1·227 at temp. 60°, and the solid saline matter as 267 in 1000. Specimens of the water taken up by Mr. Poole have been deposited at the Geological Society, together with examples of the water in which the fish were found, and of the salt spring which fed the marsh.

With respect to the *Cyprinodonts*, several of the species inhabit salt and fresh waters indifferently, the *C. Hammonis* being one of the number. It was originally discovered by Ehrenberg in the springs of the Oasis of Jupiter Ammon, and subsequently in great plenty in other districts of Egypt and Syria. M. Eloy found it in the waters of Damascus, and Rüppell states that it is an inhabitant of all parts of the Red Sea, and also of the fresh-water springs at Tor, which have a temperature of 26½° of Reaumur or 91°·6 of Fahr. This is also the temperature of one of the hot springs of Cannea in Ceylon, inhabited by the *Ambassia thermalis*. M. Renaud, on sending examples of this *Ambassia* to Cuvier, stated that the heat of the spring was 115° Fahr.; but there is reason to infer, either that his thermometer was incorrect, or that he took the temperature of the feeding spring only.

When Dr. Davy visited the springs in October 1817, the hottest well raised the thermometer to 107°, but he was told that the heat fluctuated, and had been observed as high as 110° F. There are in all seven wells, their temperatures being various, and that of one of them as low as 86°. In one only, in which the thermometer stood at 91°, did he observe fish. He thought it probable that all the wells were supplied with water from the same source (Davy's Travels in Ceylon, p. 44).

In an excursion from the south side of the Sea of Marmora to the Asiatic Olympus, Mr. Poole obtained several Cyprinoids and some Gobies chiefly from Lake Apollonia or Apollonitis near Broussa, and from the River Gemlek that falls into the Sinus Cianus. He also caught some Trout on the summit of Olympus itself. The specimens are unfortunately so much decayed that their original forms cannot be ascertained with sufficient precision, but they have much resemblance to the common *Salmo fario* of Linnæus, and like it have two longitudinal rows of teeth on the vomer, without a cluster on the front of that bone. The Cyprinoids and Gobies are in good condition.

CYPRINUS BITHYNICUS, Richardson.

The *Cyprini* resemble one another so closely, that it is matter of extreme difficulty to determine the species when unaided by correctly labelled specimens. One of Mr. Poole's fish, caught in Lake Apollonitis, has the four minute barbels of *Cyprinus carpio*, but differs

from that typical form in the great compression of its body, while it does not agree so perfectly with *C. elatus*, *hungaricus*, *Nordmanni*, and other species with deep bodies, described and figured in the 'Histoire des Poissons,' as to be referable with confidence to any of them. In general form, the origin of the barbels, position of the fins, and numbers of their rays, as well as in the outline of the preorbital and rest of the suborbital scale bones, it corresponds more closely with *C. flavipinnis* than with any other member of this group noticed in that work; but as *flavipinnis* belongs to the Indian Archipelago, a minute comparison of specimens is necessary to establish their identity. Hence I have designated Mr. Poole's fish by a geographical appellation, and shall proceed to mention the proportions of its various external parts. Its rays are, D. 4|18; A. 3|45, the last one divided to the base; P. 19; V. 9; C. 19½.

Head a very little less than a fourth of the total length, measured to the tips of the caudal lobes, or a third of the length measured to near the end of the scales on the base of that fin. Height of the body greatest at the front of the dorsal, and equal to a third of the length measured to the tips of the central caudal rays, and consequently sensibly exceeding the length of the head. The greatest thickness of the fish is in the temporal region at the upper anterior angle of the operculum, and the length of the transverse diameter at that place is contained two and a half times in the height of the body; but posterior to the head, the thickness nowhere exceeds a third of the height. The body thins off from the lateral line to the acute edge of the back, and the sides below are also flattened in, but the edge of the belly is flat to the width of the transverse insertion of the ventrals, or about equal to the diameter of the eye.

In profile the fish resembles, as we have said, *C. flavipinnis*, as represented by pl. 457 of the 'Histoire des Poissons,' but the scales are probably smaller, there being thirty-seven in our fish on the lateral line, which runs perfectly straight at mid-height throughout. Snout obtuse. Barbels like those of the species just referred to, but more slender and considerably shorter. Eyes close to the profile, about a diameter and a half of the orbit apart transversely, one diameter from the end of the snout, and one and three-quarters anterior to the gill-opening; the diameter being to the length of the head as 1 : 3·75. Length of the dorsal equal to the vertical distance between the upper surface of the ventrals and the summit of the back. The first ray of the fin stands midway between the end of the snout and the base of the caudal; the ventrals being attached immediately beneath the second soft ray. The fourth stiff ray is as usual robust and denticulated posteriorly, while the three shorter, graduated, anterior stiff rays are incumbent on its base. The third anal ray is similar to the fourth dorsal one, and stands directly under the last two branching rays of the dorsal.

Teeth.—The lower pharyngeal bone is on the whole crescentic, but of irregular form. With its fellow it embraces the lower part of the gullet in nearly a half-circle. On its interior edge there is a row of about twelve small, acutely subulate teeth. At its middle there

are three larger obtuse teeth, which stand one before the other in an antero-posterior (or dermo-central) direction, and are contiguous or incumbent on each other. The most interior one is obtusely conical, with a minute central cusp: the next, which is slightly the largest of the three, is worn on the exterior side; and the outer one is worn on both sides, but still blunt on the summit: besides these three there are two much smaller and more chisel-shaped ones, abreast of the second of the larger ones, and on its mesial side. There are thus five molar teeth on each lower pharyngeal bone, and a row of acicular or subulate tooth-like rakers on its inner border.

LEUCISCUS APOLLONITIS, Richardson.

The difficulty of grouping and describing the numerous species of this genus is acknowledged by all who have made the attempt. M. Valenciennes has shown that the labours of Agassiz, Bonaparte and other first-rate ichthyologists on the *Leucisci* have been by no means successful, nor has he himself been more fortunate in his endeavours; the small groups of species described in the 'Histoire des Poissons' being far from sufficiently precise to do away with the necessity of reviewing almost the whole genus before any member of it brought from a new locality can be rightly placed. The entire question of geographical distribution rests on the correct recognition of species; and a great advance in ichthyological science will be made, when the Cyprinoids of Asiatic Turkey, Persia, and Afghanistan shall be collected and described, so as to complete the missing links between the European and Indian forms. Enlightened travellers, therefore, like Mr. Poole, who bring home specimens of freshwater fishes from these countries, merit a grateful commendation from a Natural History Society. The specimen that we have now particularly to notice has a strong resemblance to the English Red-eye or Rudd, the Rotengle of the French, and the *Leuciscus erythrophthalmus* of Cuvier, which is the type of the subgenus *Scardinus* of Bonaparte. In this group the mandible ascends obliquely in front of the upper jaw, so that when the mouth is shut it forms the most anterior point of the fish. It happens that Mr. Poole's specimen is exactly of the same size with the figure of the Rudd in Mr. Yarrell's beautiful work, so that an exact comparison can be made between them, and the most striking difference is that the Rudd has a slightly greater height of body. The length of the head, the position of the dorsal fin, the decurvature of the lateral line, and the numbers of rays in the fins, are the same in both. The ventrals, however, are a little further forward in *L. Apollonitis*, so that the tips of the pectorals overlap them a little, and the scales are a trifle smaller, numbering two more on the lateral line. In the Asiatic fish, moreover, the profile from the point of the snout to the dorsal is less arched, being nearly straight; and the number of the pharyngeal teeth being different in the two species, we obtain a precise distinctive mark. Those of *Apollonitis* number five in the inferior or exterior row, all denticulated within and hooked at the point; while the three forming the interior row are very short, and are likewise denticulated on their

interior sides. *L. erythrophthalmus* has only four teeth in the inferior row.

As in most *Leucisci* the second dorsal ray is unbranched and tapering, and the first, which is shorter, is applied closely to its base without the intervention of membrane. In this species the second ray is the tallest in the fin, and it is perfectly flexible, without any of that stiffness which is characteristic of Agassiz' genus *Rhodeus*, in which moreover the pharyngeal teeth are chisel-shaped. The first ray of the dorsal stands on the highest point of the back, and exactly midway between the tip of the snout and the extremities of the middle rays of the caudal; while the middle of the dorsal is in the middle of the total length measured to the points of the caudal rays. The insertion of the ventrals again is midway between the point of the snout and the base of the caudal.

Rays:—Br. 3-3; D. 10; A. 13, last ray deeply divided; V. 9; C. 19½; P. 15 or 16.

Body much compressed, thinning off rapidly towards the belly: its greatest thickness is considerably above the middle, and is equal to between a third and a fourth of its utmost height. Lateral line traced along the lower third of the height, parallel to the curve of the ventral edge, and consequently very concave upwards. It is composed of forty-two scales. Under the front of the dorsal, where the body is highest, there are seven rows of scales above the row which forms the lateral line and four below, or twelve in all. The scales are dotted with black on the edges, and traversed by about four radiating lines on the exposed disk and two or three shorter ones on the covered base, all issuing from the same point. Head small, its length being contained four times and a half in the total length of the fish, measured to the tips of the caudal lobes, and being consequently perceptibly less than the height of the fish. Its breadth between the eyes is a very little in excess of the diameter of the eye, and is greater than the thickness of the body. Preorbital scale bone nearly rectangular, with the corners rounded off, a little longer than high, and traversed by an unbranched mucoduct, which is continuous with the muciferous tube of the other suborbitals: the second of these bones is narrower than the third one.

Mandible ascending and shutting against the front of the upper jaw. Its joint is directly beneath the anterior curve of the orbit. The eye is nearer to the tip of the snout than to the gill-opening, and its diameter rather exceeds a third of the length of the head. First ray of the dorsal standing midway between the tip of the snout and the extremity of the middle caudal ray; while the middle of the fin is equidistant from the tip of the snout and the distal points of the caudal lobes. Tips of the pectorals slightly overlapping the base of the ventrals, which lies midway between the end of the snout and the base of the caudal. The greatest height of body is at the front of the dorsal, and rather exceeds one-fourth of the entire length of the fish.

M. Valenciennes remarks that descriptions, even when aided by good figures, do not suffice to discriminate the nearly resembling

species of *Leuciscus*; hence this or any other proposed new species cannot be considered as properly established until it has been compared with authentic specimens of the known forms.

LEUCISCUS CII (Richardson).

This *Leuciscus* was caught by Mr. Poole in the Rivor Gemlek, anciently named Cius, which falls into the Propontis near the promontory of Posidium. Like the preceding one it belongs to the group of species which have the dorsal placed over the space between the ventrals and anal, but in this instance considerably nearer the former. Its pharyngeal teeth are in two rows, viz. five inferior taller ones, and two interior shorter ones, all incurved at the tips, and some of them distinctly denticulated on the inner edge, others only obsoletely so.

Rays:—D. 10; A. 11, the last one deeply divided, and the front one short and incumbent; V. 9; P. 18; C. 19.

In general form this fish resembles the *Leuciscus Baldneri* more nearly than it does any of the other species figured in the 'Histoire des Poissons,' but the head is a little longer, and the snout does not bulge out at the nostrils; the last ray of the dorsal also stands a little before the anus, and the anal does not occupy so much space as in *L. Baldneri*. Of the figures given by Yarrell, it has most likeness to the Grauning or *L. Lancasteriensis*.

Length of the head contained four times in the length of the fish up to the base of the caudal, or four and a half times in the length when that fin is included. The form of the head is conical. The eye approaches the upper profile, and its diameter measures about a fourth of the length of the head; it is situated a little more than a diameter from the tip of the snout, and nearly two diameters from the extreme edge of the gill-cover. Preorbital subtriangular, with its corners irregularly rounded off, and its oral border traversed by a muciferous tube having short lateral branches. The remainder of the suborbital chain unites imperceptibly with the silvery integument of the cheek, but is indicated by its muciferous tube skirting the under curve of the orbit. When the head is allowed to dry, however, the second and third suborbitals are perceived to be very narrow, and the fourth one much broader.

The height of the body is about one-fifth of the total length to the tips of the caudal, or, more exactly, a fourth of the length up to the end of the scales on that fin. It is a very little less than the length of the head. The thickness of the fish is greatest at the nape, which is much rounded, and is equal to half the greatest height of the body. The back is more obtuse than the belly. Lateral line decurved, running more than a third of the height from the rim of the belly, and traced on forty-seven scales. There are seven rows above the lateral line at the ventrals, and four below, making with the one contributing to form the line, twelve in all. Of these, two scales are below the upper ventral ray. There are about seventeen short lines on the base of a scale, and twelve or fourteen longer ones

on the exposed disk, all radiating from one point. The concentric lines of structure are crowded, but very evident.

Results obtained in the Examination of Waters.

1. Brine spring near Usdum with fish. Temp. 90° F. Spec. grav. 1·035.

2. North end of the Sea near Jordan. Temp. 83° F. Spec. grav. 1·196.

3. Dead Sea, Usdum, South end. Temp. 83° F. Spec. grav. 1·204.

4. El Lisan (Peninsula), North end. Spec. grav. 1·200.

No. 1 smelt strongly of sulphuretted hydrogen, and contained a good deal of suspended matters. No. 2 pretty clear; less sulphuretted hydrogen. Nos. 3 and 4 clear, and no sulphuretted hydrogen.—(A. W. HOFMANN.)

Calculated evaporation from the area of the Dead Sea at temp. 84° F. (58·6 dew-point) 1,500,000,000 gallons, or 6,500,000 tons. Assumed area 320 square miles (H. POOLE).

January 13, 1857.—Dr. Gray, F.R.S., in the Chair.

ON THE STRUCTURE OF THE PELVIS OF CHLAMYPHORUS TRUNCATUS. BY DR. J. E. GRAY, F.R.S., V.P. ENT. SOC., ETC.

Sir Woodbine Parish having, after considerable trouble, at length been able to procure a second specimen of this extraordinary and most interesting animal, has kindly transmitted it to the British Museum.

The specimen had been eviscerated and simply dried in the sun, was destitute of any fur, and did not afford any means of distinguishing its sex.

The Museum already possessed the well-preserved specimen formerly procured by Sir Woodbine Parish, and the imperfect skeleton of it so well described and figured by my late excellent friend Mr. Yarrell in the *Zoological Journal*, vol. iii. p. 544. t. 16.

In the specimen of the skeleton figured and described by Mr. Yarrell, the bones of the pelvis were separated to preserve the outer covering entire; the "bones being cut through as near to and as parallel with the inner surface of the plates as their confined situation would admit," p. 546.

This description did not in the least prepare me for the extraordinary structure which was discovered when the flesh was removed.

The truncated posterior disk or shield is firmly attached to the pelvis by four (or two pairs of) posterior processes, and in the central line by the elongated ridges of the posterior sacral vertebra, so as to be immoveably fixed to the pelvis. The posterior disk is thick, rather solid, and furnished with a marginal series of oblong perforations, having a second series of similar but smaller perforations within them

in the centre, and two series of much elongated curved slits on each side, near the margin, as in the figure.

Fig. 1.



Fig. 2.

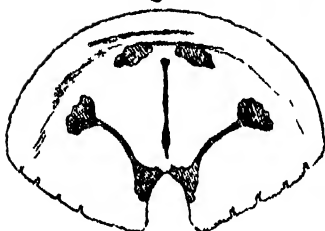
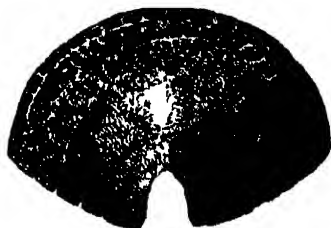


Fig. 3.



- Fig. 1. Side view of the pelvis, with the inside of the attached posterior disk.
 Fig. 2. The inside of the posterior disk, showing the position of the places of attachment.
 Fig. 3. The outer side of the posterior disk, showing the form and position of the perforations.

Professor Owen informs me that a somewhat similar adhesion of the skeleton to the dermal system is to be observed in the *Glyptodon*, and also in some of the fossil Armadilloes of the older strata.

January 27, 1857.—Dr. Gray, F.R.S., in the Chair.

DESCRIPTIONS OF THREE NEW SPECIES OF THE GENUS
 PHAETHORNIS, FAMILY TROCHILIDÆ.
 BY JOHN GOULD, F.R.S., ETC.

PHAETHORNIS VIRIDICAUDATA.

Stripe over and behind the eye light buff; crown of the head, upper surface and wing-coverts bronzy grass-green, duller on the head; wings purplish brown; tail-feathers bronzy grass-green at the base, passing into dark brown towards the extremity, the cen-

tral feathers tipped with white; the next margined on each side at the tip with white, and the remainder with white on the apical portion of the external web; under surface reddish buff, becoming paler on the abdomen and vent; upper mandible black; basal two-thirds of the lower mandible yellow, tip black; legs yellow.

Total length, $3\frac{3}{4}$ inches; bill, 1; wing, $1\frac{1}{4}$; tail, $1\frac{1}{4}$.

Hab. Rio de Janeiro.

Remark.—This species belongs to that section of the *Phaethornis* to which Prince Charles L. Bonaparte has given the generic appellation of *Pygmornis*; in other words, it is allied to the *P. eremita*, *pygmæus* and *griseogularis*, but differs from all in the absence of any red on the rump, and in the green colouring of the base of the tail.

PHAETHORNIS EPISCOPUS.

Head, upper surface and wing-coverts rich golden brown; behind the eye a stripe of buff, wings purplish brown; tail deep bronzy brown at the base, changing into slaty brown near the apex, and slightly tipped with grey; rump rufous; ear-coverts black; under surface deep sandy buff, crossed on the breast by a broad band of jet-black; somewhat elongated plumes; upper mandible and apical third of the lower mandible black; basal two-thirds of the latter yellow.

Total length, $3\frac{1}{2}$ inches; bill, $\frac{7}{8}$; wing, $1\frac{1}{4}$; tail, $1\frac{1}{4}$.

Hab. Demerara.

Remark.—This species differs from both *P. pygmæus* of Spix and *P. eremita* in the rich bronzy colouring of its upper surface, in the greater breadth of the black pectoral band, the deep bronzy hue of the tail, and the small size of its short and rounded wings.

PHAETHORNIS OBSCURA.

Head, upper surface, and wing-coverts dark bronzy green; stripe behind the eye buff; wings purplish brown; tail dark bronzy brown, each feather narrowly margined externally and slightly tipped with white; throat smoky black, between which and the eye a stripe of light buff; chest clouded chestnut, passing into dark grey on the abdomen, and fading into buffy white on the vent; under tail-coverts greyish white; upper mandible and tip of the lower black; basal three-fourths of the latter yellow.

Total length, $3\frac{3}{4}$ inches; bill, $\frac{7}{8}$; wing, $1\frac{1}{4}$; tail, $1\frac{1}{4}$.

Hab. Rio de Janeiro.

Remark.—This is also one of the smaller species, which, like *P. viridicaudata*, would pertain to Prince C. L. Bonaparte's genus *Pygmornis*. It differs from all others yet known in its darkly coloured throat and under surface.

MISCELLANEOUS.

Note on the Anatomy and Physiology of the Pulmoniferous Mollusca.
By Dr. C. SEMPER.

THIS memoir contains several interesting data upon the histology of the Gasteropoda. The author has carefully studied the glandular follicles of the skin, which had previously been much neglected. He thinks he has ascertained that the external layer of the shell of the Pulmonata, or the epidermis of the shell, which is probably composed of conchioline, owes its formation to two different kinds of follicles, whilst the inner layer of the shell would be formed by the precipitation of calcareous salts secreted by the epidermic follicles of the animal. Semper appears to have had no doubt as to whether this inner layer possesses an organic base.

As regards the pedal gland, originally discovered by Delle Chiaje and Kleeberg, and which Leydig and Deshayes regard as an organ of smell, Semper agrees with Siebold in only considering it as an apparatus destined to secrete a mucosity.

Amongst many details relative to the circulation of the blood, and the organs connected therewith, we shall only refer to one fact, namely that the lung of the Pulmoniferous Gasteropods is destitute of epithelium in the region where the exchange of gases takes place, whilst the other parts of the organ, where the large vessels exist, are clothed with a vibratile epithelium.

If Semper's memoir presents many interesting details, it also contains some manifest errors. In all the Gasteropoda the tongue is supported by an apparatus composed of one or several cartilages. Lebert, many years ago, recognized the nature of this organ, and described and figured the cartilaginous cells. Semper asserts that Lebert was mistaken, that there is no lingual cartilage, and that what Lebert believed to be cartilaginous cells are only transverse sections of muscular fibres. In this case Lebert would certainly have been guilty of a gross mistake, and we might justly have been surprised if so experienced an observer could have committed such error. Unfortunately for Semper, Lebert was perfectly right, and the lingual cartilage really exists. Semper's error arises from his having confined his researches to the Pulmonata, in which the study of the lingual cartilage is really very difficult. If he had turned to some Pectinibranchiata, such as the *Neritina*, the *Buccini*, or the *Turbonæ*, or to some Cyclobranchiata, such as the *Patellæ* and *Chitons*, or even to some operculated Pulmonata, such as the *Cyclostomata* and the *Pomatia*, he would have been careful not to accuse Lebert of so grave an error.

We are no more in accordance with Semper as regards the part played by the tongue in deglutition. The description given by Troschel of the functions of the lingual apparatus appears to be far more natural and correct. In the trituration of the food, Semper gives importance to the posterior papilla of the tongue, an organ

which has hitherto been neglected by almost all observers, but which does not in all cases play the part attributed to it by Semper. Here again, the error arises from his having limited his investigations to the Pulmonata. If he had examined certain Gasteropoda in which the ribbon-shaped tongue is as long as the body, as in the *Pomatia*, or even much longer, as in the *Patella*, he would soon have been convinced that the posterior papilla, placed quite at the bottom of the abdominal cavity between the folds of the intestine, never comes in contact with the food. This papilla is in fact the producing organ, the matrix of the rows of teeth which form the radula. In proportion as the anterior rows of teeth are worn and thrown off, new ones, destined to replace them, are formed behind.—*Siebold and Kolliker's Zeitschrift*, viii. p. 340–399. Abstract by E. Claparède in *Bibl. Univ. de Genève*, January 1857, p. 79.

Note on the Invertebrate Fauna of the Baltic Sea.

By G. LINDSTRÖM.

We are accustomed to consider the Baltic as very poor in the lower animals and plants, but this poverty is not so great as has been hitherto supposed. It is certain, however, that most of the species discovered during the last few years belong to the North Sea, and that there is only a very small number belonging to the Baltic itself. But it is precisely the latter, such as *Idothea entomon* and *Pontoporeia affinis*, which possess a peculiar interest from the resemblance which they present to certain arctic forms (*Idothea Sabini* and *Pontoporeia femorata*).

Many species which were hitherto supposed to belong to more northern seas are able to live in the comparatively fresh water of the Baltic, and even the mixture of marine and freshwater forms gives a very peculiar character to the fauna of the rocky pools in the vicinity of Stockholm. Amongst the Invertebrata, the Crustacea furnish the greater part of the marine species which are capable of bearing this half-fresh water without losing their purity of type. There are but few Mollusca in this case, and even amongst the animals of this division there are some which have so modified their original form that they have been taken for species peculiar to the Baltic; as, for instance, *Tellina solidula*.

Not far from Wisby the coast sinks so gently, that at a distance of half a mile from the shore the depth does not exceed 40 fathoms. Close to the shore, where the depth of water is not more than a few feet, the bottom is formed of calcareous pebbles covered with various marine Confervæ, with *Enteromorpha intestinalis*, &c. There, *Gammar*, *Planaria*, *Limnæa* and *Neritina* (*Neritina fluviatilis*) move about. If we advance further into the sea, we find a bank of marly limestone belonging to the formation of Gothland, and covered with *Fucus vesiculosus* and with *Chorda flum.* At a depth of 8–15 fathoms, *Ceramia*, *Polysiphonia* and *Furcellaria* grow. In this zone we find an abundance of *Mytilus edulis*, *Amphitet*, *Paludinella*,

Cardia, and *Limapontia*, and also *Gammarus locusta*, which is met with wherever Algae occur.

Beyond this zone there is a sand covered with a fine clay. In this region few animals are met with, and these are either Mollusca (*Mya*, *Tellina*) or Amphipod Crustacea.

The *Skärgård* of Stockholm possesses a singular fauna. Under the stones which are close to the shore we meet with *Gammari* (*G. locusta*), species of *Jæra*, *Planaria*, and *Nais*, and with young Acephalous Mollusca belonging to the genera *Cardium* and *Tellina*. At a depth of 2-5 fathoms, *Fucus vesiculosus* grows; upon this vegetate *Elachistæ* and various Confervæ. This region swarms with *Mysis*, *Jæra*, *Gammarus*, *Paludinella*, *Mytilus*, with young *Cardia* and with *Flustræ*; even *Phryganidæ* are found there. From a depth of 5 or 6 fathoms to that of 18 the bottom is clayey and muddy; here and there only *Phyllophoræ* grow, together with *Ceramia* and *Poly-siphoniæ* in a stunted condition. The fauna of this zone is richer than would be supposed at the first glance. At a depth of 8 fathoms occurs *Asellus vulgaris*, a freshwater species, in the midst of the *Phyllophoræ*. At a depth of 3-6 fathoms, *Limnæus pereger* (var. *Balticus*) and *Physa fontinalis*! are met with. Near Gothland, Lindström has even found *Limnæi* in the open sea at a depth of 8 and 12 fathoms! How can we explain the existence of air-breathing animals so far from the surface? Do they possess a means of rising and sinking rapidly in the water at pleasure, or must we admit that they only require to renew the air in their pulmonary sac at long intervals? By the side of these *Limnæi* there were living completely marine animals, such as *Nereides*, *Polynoës*, a species of *Sipunculus*, *Tellinæ* and *Cardia*. At a depth of 40 fathoms, nothing is found but a *Pontoporeia*, an *Idothea*, and a *Tellina*.

In the open sea a multitude of small animals are found moving about on the surface; these are principally Crustacea, such as *Eudæne*, and also larvæ of Gasteropoda (*Tergipes*) and Acephala. A Diatomaceous plant floats in the midst of these little creatures: it is sometimes so incredibly abundant as to produce what is called on the coasts of Gothland, *the flowering of the sea* (*hafvets blomning*). In the middle of summer it propagates with such rapidity, that the fishermen assert that their boats can hardly pass through the dense layer formed by it.

In a narrow *Sund* near Stockholm, called *Gälö-strät*, the soil is covered with *Myriophyllum* and *Potamogeton*. In the water sport Cyprinæ and other freshwater fishes, as well as Eutomostraca also belonging to the fresh waters (*Daphnia*, &c.). At the bottom *Paludina impura* is seen creeping, and yet close beside are *Tergipes* and other marine forms.—*Öfversigt af Kongl. vetensk. Akad. Förhandl. Stockholm*, 1855, p. 49; and *Bibliothèque Univ. de Genève*, January 1857, p. 71.

The Blacks of Moreton Bay and the Porpoises. By Mr. FAIRHOLME.

Between the two long islands which form the south part of Moreton Bay, is a passage known as the South Passage, formerly used
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for ships entering the Bay, but now given up. Near the deserted Pilot Station at Amity Point, some of the natives may constantly be found during the warmer months of the year fishing for "Mullet," a very fine fish about the size of a mackerel. In this pursuit they are assisted in a most wonderful manner by the Porpoises. It seems that from time immemorial a sort of understanding has existed between the blacks and the Porpoises for their mutual advantage, and the former pretend to know all the Porpoises about the spot, and even have names for them.

The beach here consists of shelving sand, and near the shore are small hillocks of sand, on which the blacks sit, watching for the appearance of a shoal of Mullet. Their nets, which are used by hand, and are stretched on a frame about 4 feet wide, lie ready on the beach. On seeing a shoal, several of the men run down, and with their spears make a peculiar splashing in the water. Whether the Porpoises really understand this as a signal, or think it is the fish, it is difficult to determine, but the result is always the same; they at once come in towards the shore, driving the Mullet before them. As they near the edge, a number of the blacks with spears and hand-nets quickly divide to the right and left, and dash into the water. The Porpoises being outside the shoal, numbers of fish are secured before they can break away. In the scene of apparent confusion that takes place, the blacks and Porpoises are seen splashing about close to each other. So fearless are the latter, that strangers, who have expressed doubts as to their tameness, have often been shown that they will take a fish from the end of a spear, when held to them.

For my own part I cannot doubt that the understanding is real, and that the natives know these Porpoises, and that strange Porpoises would not show so little fear of the natives. The oldest men of the tribe say that the same kind of fishing has always been carried on as long as they can remember.

Porpoises abound in the Bay, but in *no other part* do the natives fish with their assistance.—*Proc. Zool. Soc.* Nov. 11, 1856.

EOLIS LANDSBURGII.

To the Editors of the Annals of Natural History.

Northumberland Place, Morecambe, Lancaster.

GENTLEMEN,—It may interest some of the contributors and subscribers of the *Annals of Natural History* to know that a specimen of the *Eolis Landsburgii*, of about 1½ inch in length, was dredged off the coast of Morecambe Bay by myself and a friend. The *Eolis Landsburgii* is mentioned by Alder and Hancock, in their work published by the Ray Society, as only having been found once, and then by Dr. Landsborough, after whom it is called, at Saltcoats; but as the work referred to was published in 1849, more specimens may have been since found*.

Your obedient Servant,

I. JNO. MOSER.

* Our correspondent will find a note on its occurrence near Exmouth in the *Annals* for January 1852.—ED.

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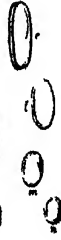
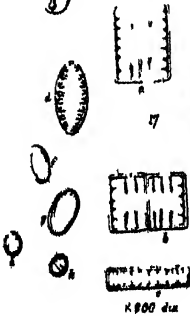
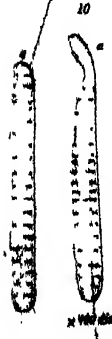
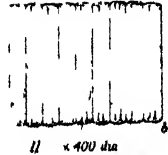
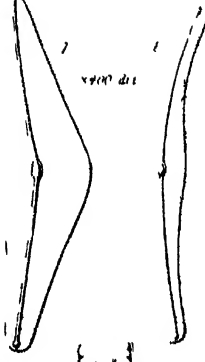
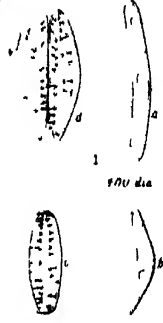
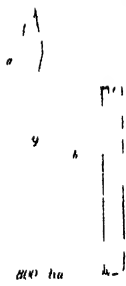
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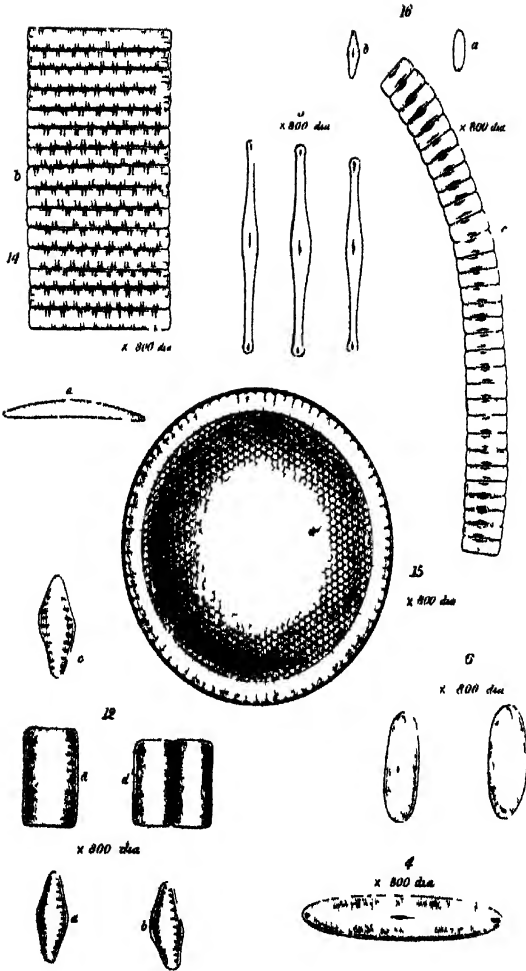
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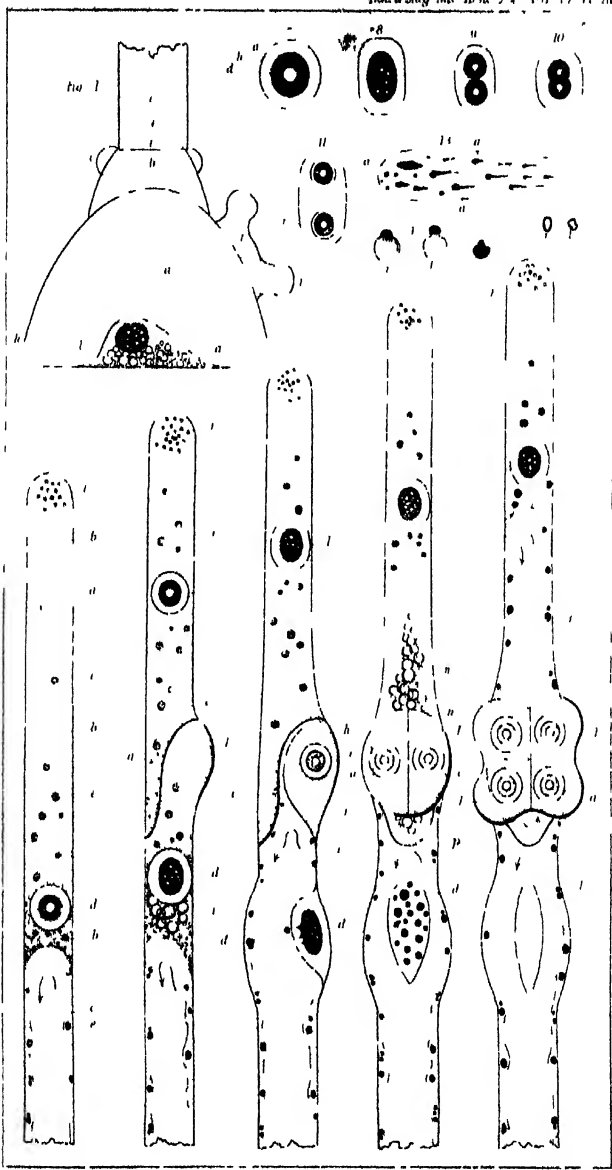
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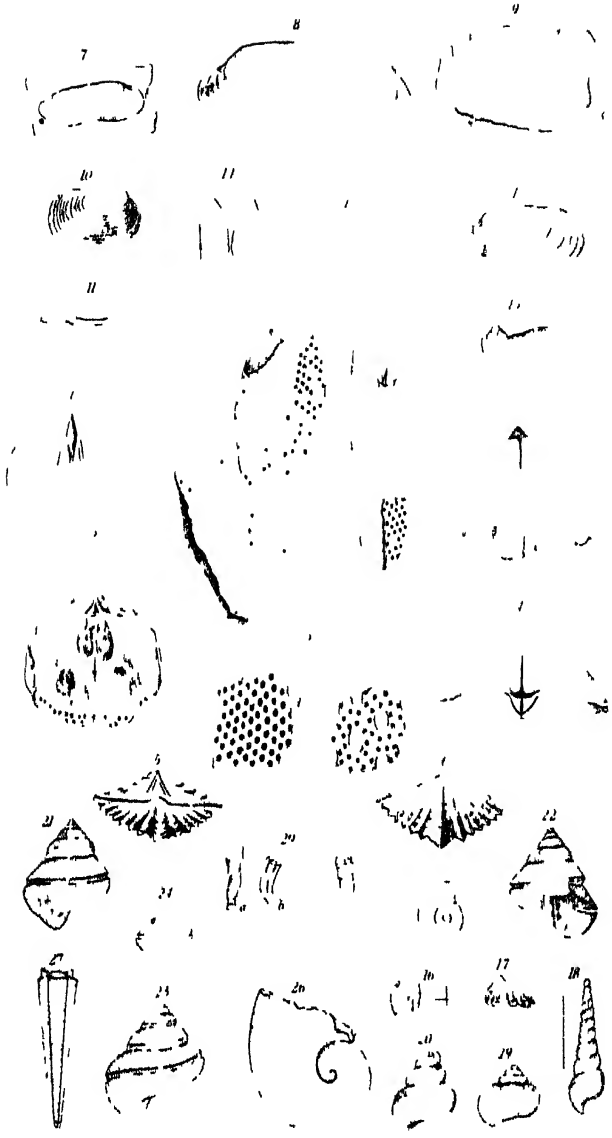
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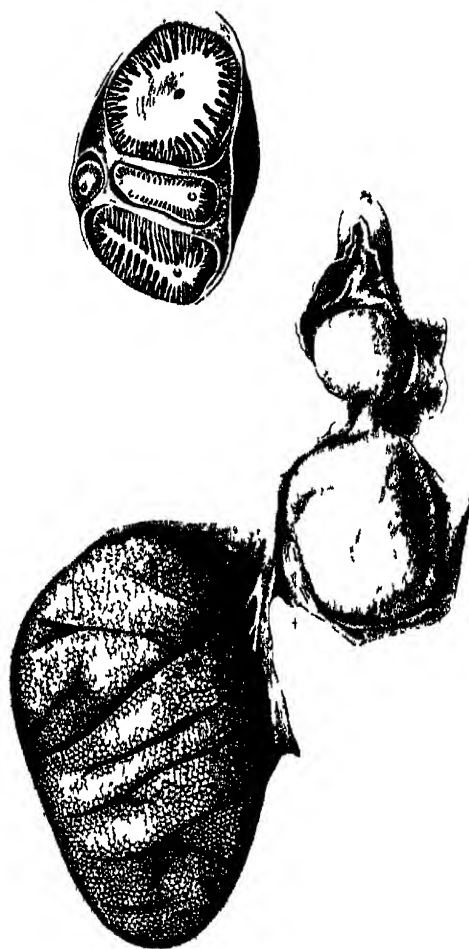


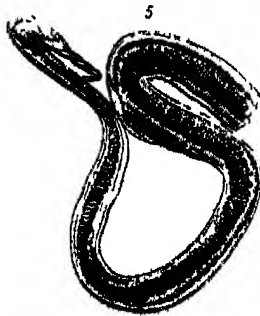


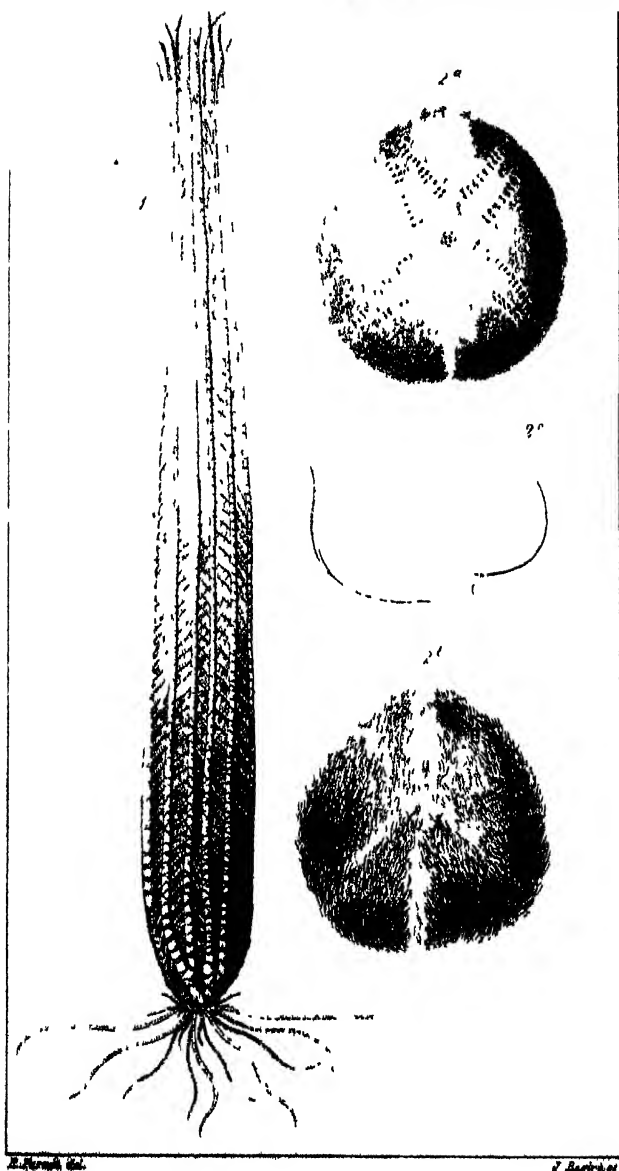


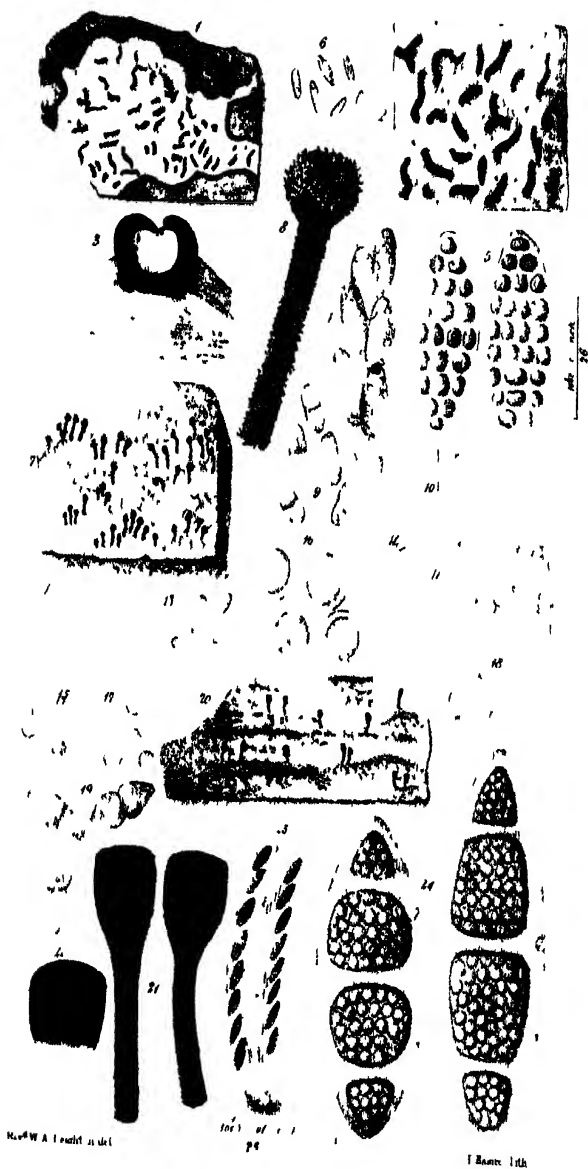








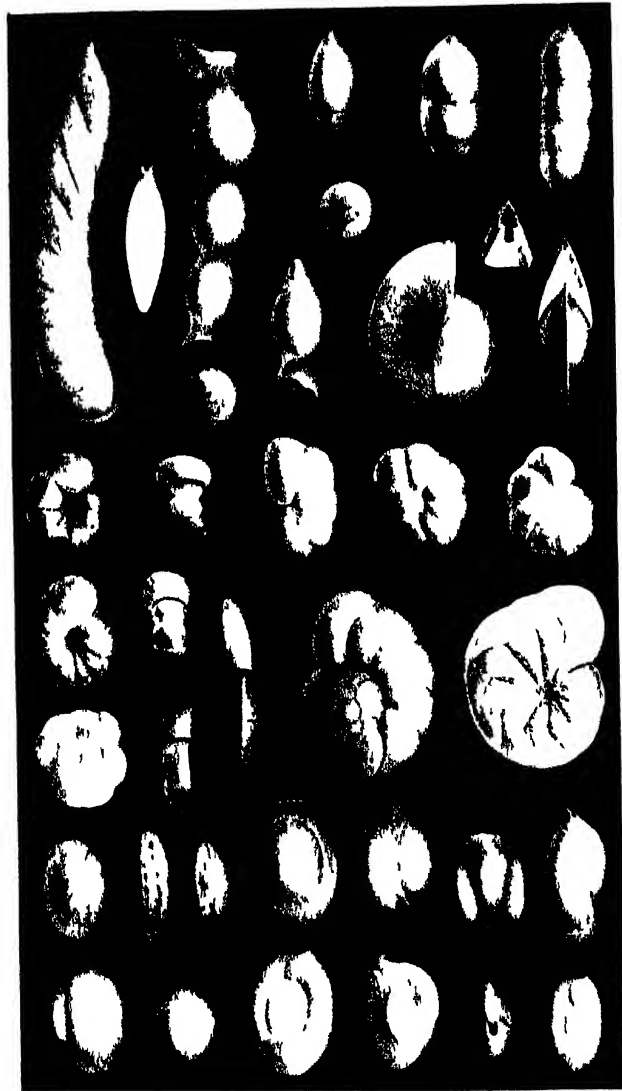




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RHIZOPODA from the Coast of Norway



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RHIZOPODA from the Coast of Norway

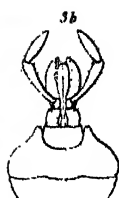


Figure 1

Figure 2

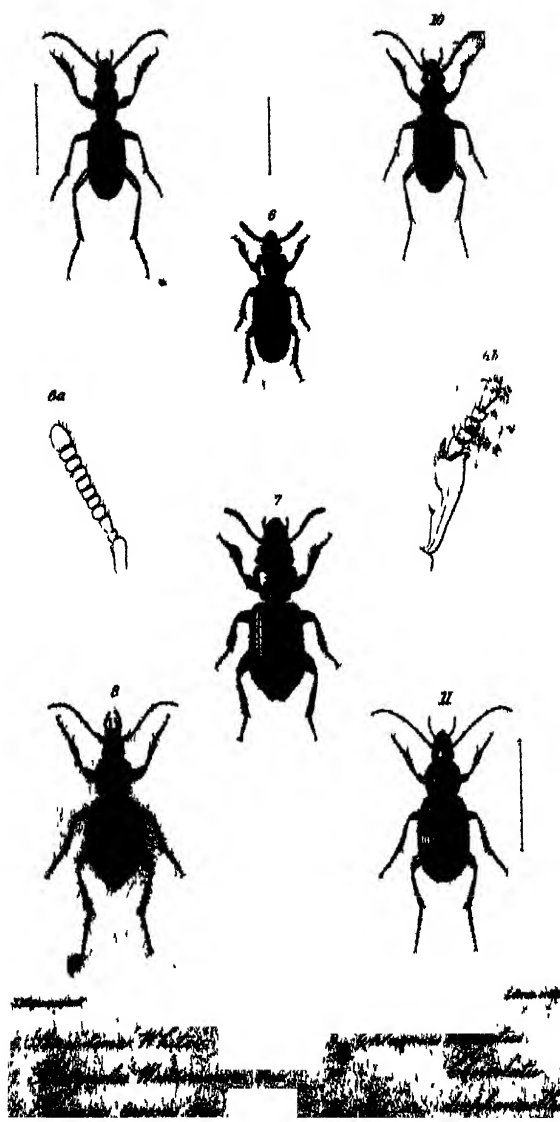
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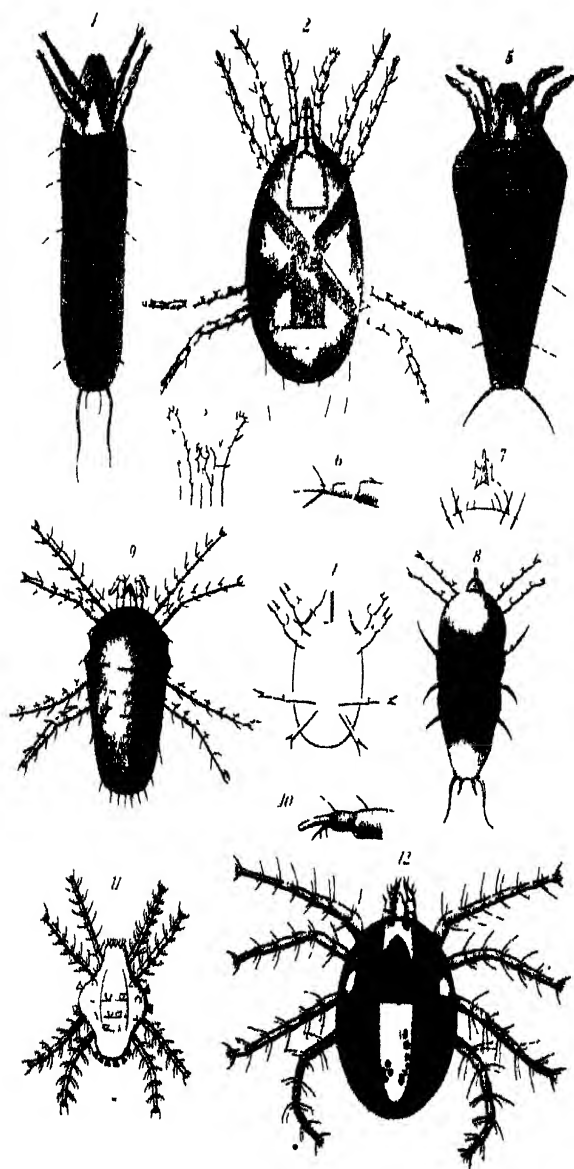
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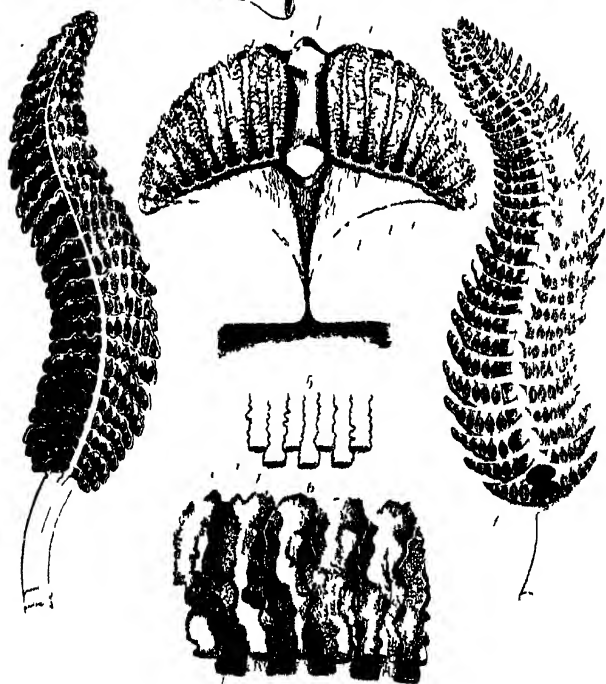
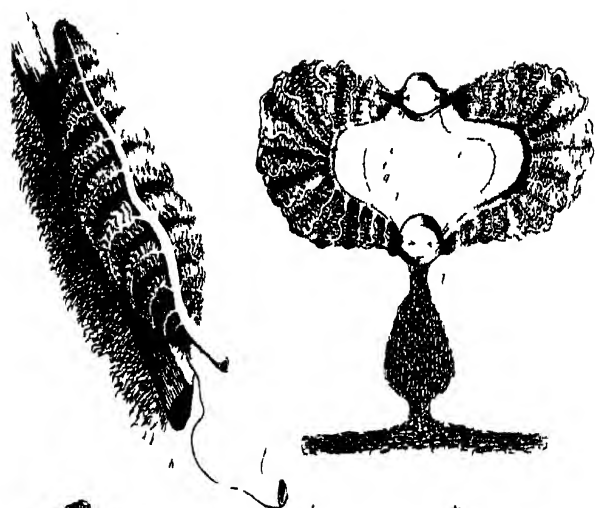
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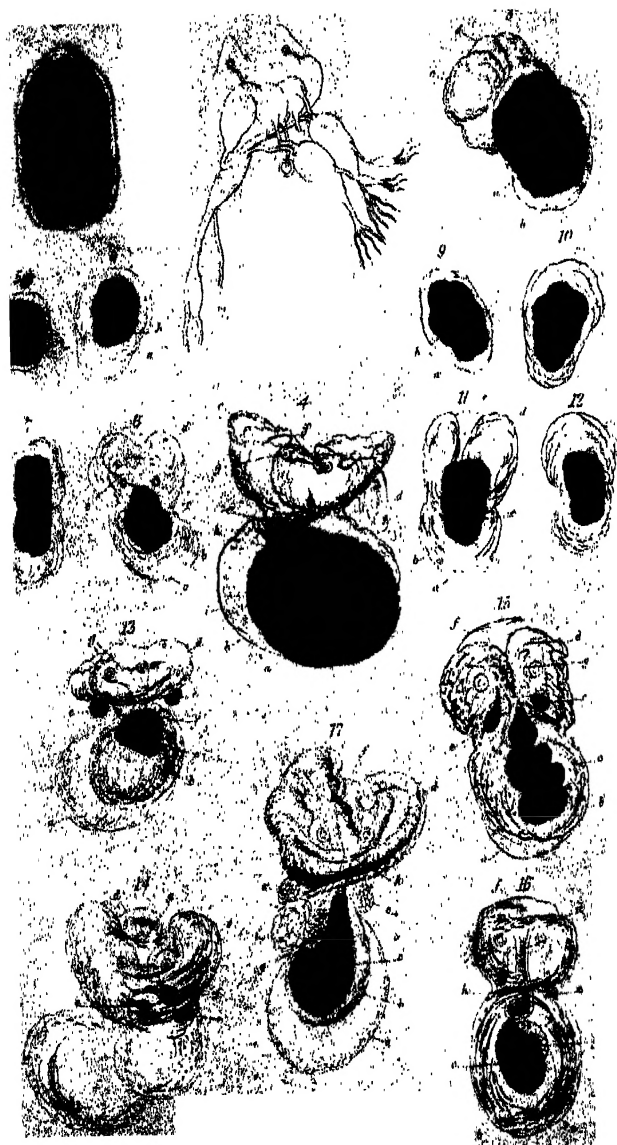
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